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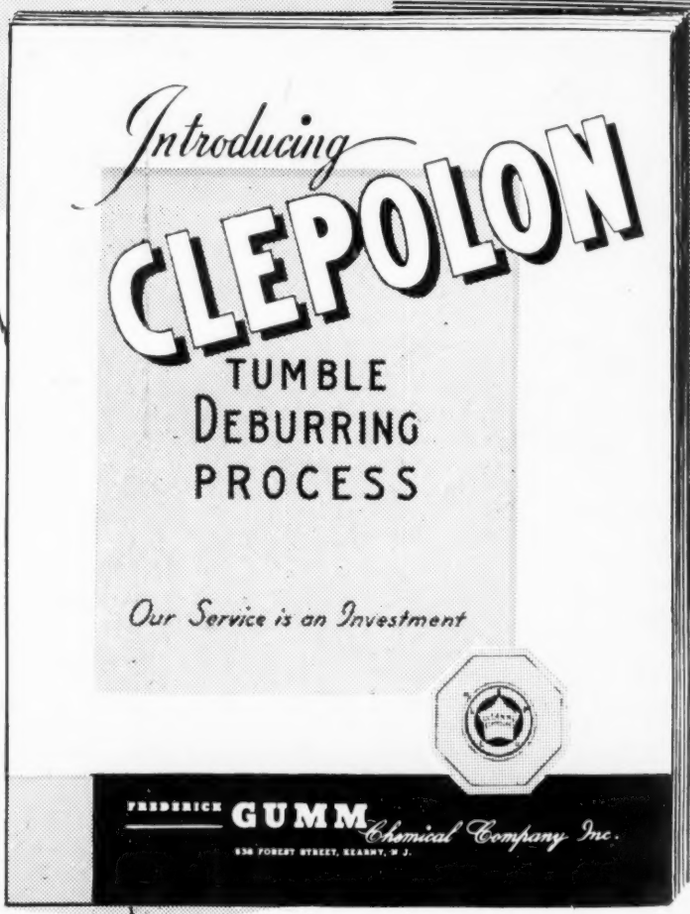

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METAL FINISHING

PREPARATION, ELECTROPLATING, COATING

Founded as Metal Industry, January, 1903 by Palmer H. Langdon, 1868-1935

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COMING SOON

A method of laboratory control for aluminum anodizing color baths by means of simplified and inexpensive test equipment.

•

Improved hard chromium plating processes as developed during the late war by the British Government.

Simplified economical means of identifying plated coatings without the use of elaborate laboratory equipment.

•

A summary of events of interest to metal finishers during the year 1907, including some amusing shop problems.

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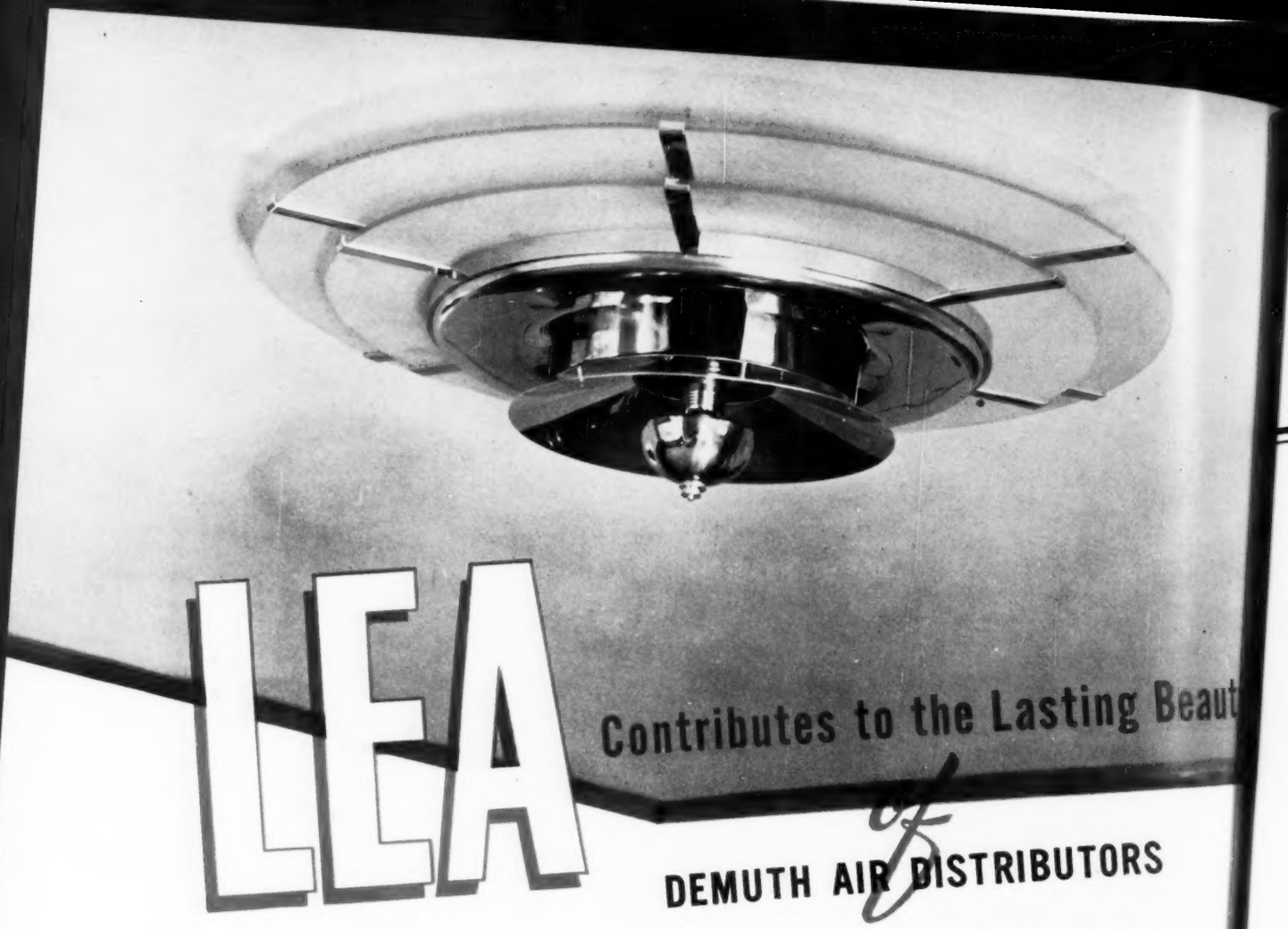

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Demuth provides another good example of a company with a buffing problem being helped by LEA. Perhaps you, too, need technical assistance in solving some polishing, buffing, or burring problem. If so, why not call on LEA? If possible, send samples for laboratory method testing.

THE LEA MANUFACTURING CO.

16 CHERRY AVENUE, WATERBURY 86, CONNECTICUT

Burring, Buffing and Polishing . . . Manufacturers and Specialists in the Development of Production Methods and Compositions

VOL. 44, NO. 11 METAL FINISHING NOVEMBER, 1946
PREPARATION, ELECTROPLATING, COATING

Metal Finishing Obstacles

With the prospect of many billions of dollars worth of peace-time products still to be given decorative finishes before the demand is met, metal finishers are in general poorly prepared for the additional effort required. The causes for this condition do not always lie with the metal finisher. Inability to obtain equipment and supplies, labor controversies, price limitations and government regulations are certainly no fault of the plater. On the other hand, the metal finisher must exercise all his ingenuity to overcome these obstacles with what facilities are available.

Many possibilities exist for this to be done. With long waiting lists for certain types of specialized equipment, the finisher must adapt his available setup to higher production schedules; one way of doing this is to install second and third daily shifts, thus not only reducing overhead costs, but eliminating many hours used in gathering momentum in the plating cycle.

The supply shortage requires a flexible plant. With buffs hard to get, the polisher must keep trimming his wheels to smaller and smaller diameters; this means lower wheel surface velocities for which adjustment must be made in either the method or equipment. Perhaps other types of equipment or processes will do the job just as well; at least they must be thoroughly investigated. The shortage of some metals and their salts in the plating shop requires considerable maneuvering; the plater must find a more plentiful metallic finish to supplant the one he cannot obtain. This means investigation of the field; it is surprising the number of metallic finishes that are interchangeable in appearance and application method.

Labor controversies require patience, fortitude, tact, from all concerned. Price limitations and government regulations are slowly fading from the industrial scene; all the more reason for metal finishers, who are among the most highly specialized in industry and therefore among the most responsible, to exercise discretion and judgment. Going the whole hog when restrictions are lifted only means a disappointing lack of business when conditions are normal.

In this period of industrial difficulties, resourcefulness, fortitude, tact and judgment are the watchwords.

National Metal Congress to be Held in Atlantic City

Monday, Tuesday and Wednesday, November 18, 19 and 20—12 noon to 10:30 p. m.
Thursday and Friday, November 21 and 22—10:00 a. m. to 6:00 p. m.

SEVENTY-NINE simultaneous sessions of four technical societies will be held when the 28th annual National Metal Congress meets at Atlantic City during the week of November 18th.

The simultaneous sessions will include technical sessions during morning, afternoon and evening periods, educational lectures, annual meetings, dinners, banquets and many special lectures. Technical societies participating in the Congress are the American Society for Metals, sponsors of the event as well as the National Metal Exposition which will be held at the same time in the Municipal Auditorium; The American Welding Society; The Iron and Steel Division of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers, and the American Industrial Radium and X-Ray Society.

A.S.M. headquarters will be at the Traymore Hotel; the A.W.S. will be at the Ambassador; the A.I.M.E. at the Claridge Hotel, and the Radium and X-Ray Society at the Seaside.

Twenty-two educational lectures and sixty-four technical papers will be presented by the American Society for Metals. This is the largest number of papers ever scheduled by A.S.M. for it annual convention. The educational lectures deal with *The Structure of Cast Iron, Physical Metallurgy of Aluminum, Sleeve Bearing Metals,* and *Electronic Methods of Inspection of Metals.*

Three simultaneous sessions will be held each morning beginning at ten o'clock, except Wednesday which is reserved for the important Campbell Memorial Lecture by Dr. J. B. Austin of the U. S. Steel Corp., and the annual meeting of the Society. Two sessions will be held each afternoon beginning at 2 o'clock. Lecture courses are scheduled for presentation during afternoon and evening periods.

Admission to the National Metal Exposition is free to all members of technical societies and to those holding invitations distributed by participating firms. Members of any technical society can register free upon presentation of their membership cards or by presenting their business card at the registration desk in the Municipal Auditorium. There will be no paid registration.

Two papers of especial interest to the metal finishing field are to be given. The first, to be presented on Wednesday, November 20 at 2 p. m. in Session 2, will be *Stress Cracking of Electroplated Lockwashers,* by K. B. Valentine, Pontiac Motor Div., General Motors Corp. The second, to be given Friday, November 22 at 2 p. m. is entitled *Measurement of Embrittlement During Chromium and Cadmium Electroplating and the Nature of Recovery of Plated Articles,* by Carl A. Zapffe and M. Eleanor Haslem, Baltimore, Md.

At the annual meeting of the Society on Wednesday morning, President C. H. Herty, Jr., Treasurer H. K. Work and Secretary W. H. Eisenman will present their annual reports. The Society's annual elections will follow. Nominees (unopposed) for officers and trustees include: for president: A. L. Boegehold, head of Metallurgical Department, General Motors Research

Laboratory, Detroit; for vice-president: F. B. Foley, director of research, The Midvale Co., Nicetown, Pa.; for secretary: W. H. Eisenman (incumbent), American Society for Metals, Cleveland; for trustee: A. E. Focke, director of research, Diamond Chain and Manufacturing Co., Indianapolis, Ind., and J. E. Dorn, Professor of Physical Metallurgy at the University of California.

The A.S.M. annual banquet will be held on Thursday evening, November 21st, at the Traymore Hotel. Walter S. Towers, president of the American Iron and Steel Institute, will be the principal speaker. On the same occasion the Albert Sauveur Achievement Award will be made to Dr. E. C. Bain, vice-president, Carnegie-Illinois Steel Corp.; Dr. R. E. Zimmerman, vice-president, the United States Steel Corp., will receive the A.S.M. Medal for the Advancement of Research; and the Henry Marion Howe Medal will be presented to Dr. C. R. Austin, Mechanite Metal Corp., and to Dr. M. C. Fetzer, Carpenter Steel Co.

The Alumni Luncheons, always well attended at A.S.M. conventions, this year will be held in the Traymore Hotel on Thursday noon, November 21st. Eleven colleges and universities have announced their luncheons. They are Carnegie Institute of Technology, Massachusetts Institute of Technology, Missouri School of Mines, University of Minnesota, University of Cincinnati, University of Michigan, Ohio State University, Yale University, Lehigh University and Pennsylvania State College. Other technical schools are expected to make similar arrangements.

The American Welding Society will present its medals and prizes at a dinner in the Ambassador Hotel on Thursday evening, November 21st. Dr. W. F. Hess of the Rensselaer Polytechnic Institute will deliver the Adams Lecture on Monday evening. Section officers of A.W.S. will hold their annual dinner in the Venetian Room of the Ambassador on Wednesday evening, November 20th, at 6:30 p. m. The dinner will be followed by a discussion of Section activities.

William Hume-Rothery of Oxford University, Oxford, England, addresses the Institute of Metals Division of the A.I.M.E. on Tuesday morning at Hotel Claridge. The Annual Fall dinner of the Iron and Steel and Institute of Metals Division of the A.I.M.E. will take place on Tuesday evening, November 19, at Hotel Claridge.

Dr. Kent R. Van Horn, president of the American Industrial Radium and X-Ray Society, will make his retiring address before the Society on Thursday morning, November 21st, in the Main Ballroom of the Seaside Hotel. At the same session, election of officers will be held. Dr. Van Horn will receive the Mehl Lecture Award of the Society at that time.

It is expected that approximately 15,000 persons will attend the Exposition and the National Metal Congress which will take place at the same time in the Atlantic City Municipal Auditorium.

Heat treating equipment, testing machines, laboratory supplies, machine tools, cutting oils, every type of equipment or process that plays a part in metal production and fabrication will be represented by a number of the country's leading producers.

Forty-three instrument manufacturers, and thirty-six companies displaying materials and processes for metal cleaning and finishing will insure that every new development in these lines can be seen, examined, explained and demonstrated.

Firms connected with the cleaning, metal and organic finishing, and allied fields who will have exhibits at the show are listed in alphabetical order below. The space number in the Atlantic City Municipal Auditorium is given after the name of each exhibitor:

Alvey-Ferguson Co., The Cincinnati 9, Ohio	A230
American Foundry Equipment Co. Mishawaka, Ind.	B115
American Smelting & Refining Co. Federated Metals Division New York 5, N. Y.	E178
Baker & Co., Inc. Newark 5, N. J.	C225
Better Finishes & Coatings, Inc. Newark 5, N. J.	A138
Blakeslee & Co., G. S. Chicago 50, Ill.	D205
Bristol Co., The Waterbury 91, Conn.	C142
Brown Instrument Co. Philadelphia 44, Pa.	B105
Carbomatic Corp. New York 23, N. Y.	G169
Crown Rheostat & Supply Co. Chicago 18, Ill.	E157
deSanno & Son, Inc., A. P. Philadelphia 2, Pa.	A181
Diversey Corp., The Chicago 4, Ill.	B143
DuMont Labs., Allen B. Passaic, N. J.	E221
Eclipse Fuel Engineering Co. Rockford, Ill.	G169
Foxboro Co., The Foxboro, Mass.	B142
Gehnrich & Gehnrich, Inc. Woodside, Long Island, N. Y.	G169
General Electric Co. Schenectady, N. Y.	H139
Goodrich Co., The B. F. Akron, Ohio	G173
Hammond Machinery Builders, Inc. Kalamazoo 54, Mich.	A138
Handy & Harman New York 7, N. Y.	F147
Houghton & Co., E. F. Philadelphia 33, Pa.	D115
Industrial Tape Corp. Brunswick, N. J.	A224

International Nickel Co. ..... Stage
New York, N. Y.

Kolene Corp. J233
Detroit 2, Mich.

Lea Manufacturing Co. G232
Waterbury 86, Conn.

Leeds & Northrup Co. A122
Philadelphia 44, Pa.

Maas & Waldstein Co. G177
Newark 4, N. J.

Mabor Co. F215
Rahway, N. J.

Mallory & Co., Inc., P. R. G228
Indianapolis 6, Ind.

McAleer Manufacturing Co. A137
Rochester, Mich.

Metal Finishing F214
New York 18, N. Y.

Metal Finishing Service D236
Chicago 1, Ill.

Mines Safety Appliances Co. B119
Pittsburgh 8, Pa.

Minneapolis-Honeywell Regulator Co. B105
Philadelphia 44, Pa.

Miskella Infra-Red Co. A235
Cleveland 4, Ohio

Oakite Products, Inc. H159
New York 6, N. Y.

Ohio Carbon Co., The E209
Cleveland 11, Ohio

Pangborn Corp. H173
Hagerstown, Md.

Park Chemical Co. C143
Detroit 4, Mich.

Peters-Dalton, Inc. H232
Detroit 12, Mich.

Phillips Manufacturing Co. D174
Chicago 45, Ill.

Pulmosan Safety Equipment Corp. C159
Brooklyn 1, N. Y.

Ransburg Co., Harper J. A170
Indianapolis 7, Ind.

Ransohoff, Inc., N. C245
Cincinnati, Ohio

Roberts Rubber Co. Weldon E249
Newark, N. J.

Safety Clothing & Equipment Co. E228
Cleveland 3, Ohio

Selas Corp. of America G169
Philadelphia, Pa.

Solvental Chemical Products, Inc. E179
Detroit 3, Mich.

Sparkler Manufacturing Co. F228
Mundelein, Ill.

Sun Oil Co. F105
Philadelphia 3, Pa.

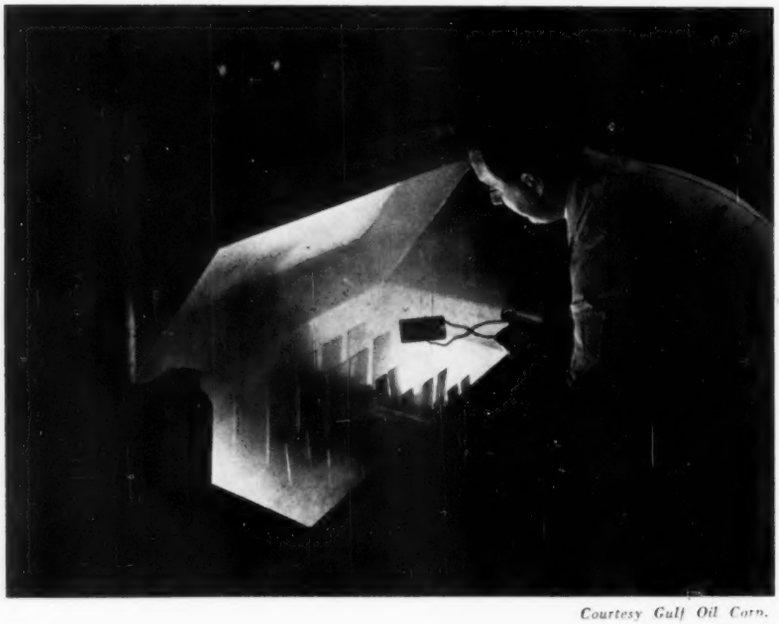
Sunbeam Corp. D163
Chicago 50, Ill.

Torit Manufacturing Co. B176
St. Paul 2, Minn.

Udylite Corp., The G141
Detroit 11, Mich.

Vacu-Blast Co., The F226
Burlingame, Calif.

Vapor Blast Mfg. Co. F235
Milwaukee 3, Wisc.



Courtesy Gulf Oil Corp.

Salt Spray Test Against Corrosion

One step in the constant battle of science to protect metals exposed to marine conditions from corrosion is revealed in this picture of a salt spray cabinet in use. Metal panels coated with experimental rust-preventive compounds are here subjected to a mist of synthetic seawater at a temperature of 100° F. The effect of months of exposure can be ascertained in a few days, enabling testing of thousands of compounds yearly to improve protection of deckloads aboard ship, machinery and installations on ship and shoreline, and naval ordnance. The spray cabinet is only one of many testing devices in the corrosion section of the research laboratories of Gulf Oil Corporation.

Electroplating, Polishing and Buffing
At the U. S. Naval Gun Factory, Washington, D. C.

By ALBERT L. FRY
Master Mechanic

POLISHING and buffing as a separate activity was started at the U. S. Naval Gun Factory in Washington in 1898. In 1908 electroplating tanks for nickel, copper and silver were installed in a lean-to on the buffing shop for the purpose of electroplating such items as torpedo details, 1- and 6-pounder gun parts and the bright work and silverware for the Presidential yachts. Very little ordnance material was electroplated prior to World War I, and the service of only one employee was required to do all the electroplating for the Gun Factory.

In 1923 the electroplating and buffing activities were combined in one building and designated the Buffing and Plating Shop. At that time additional electroplating processes were installed that enabled the shop to expand its plating activities. A new process of lead-tin alloy plating was developed for torpedo details, and cadmium plating was introduced for rustproofing other ordnance material. This new equipment for these activities included tanks of sufficient size to permit the cadmium plating of gun mounts for 4", 5" and 6" guns. Cadmium plating proved very beneficial in protecting ordnance material from the corrosive action of salt sea water and was adopted as a standard requirement for many parts. The use of cadmium plating saved many thousands of dollars' worth of ordnance material from deterioration due to corrosion. This resulted in such an increase in the demand for electroplating that further expansion of the electroplating facilities was required. Additional space was provided by transferring the Polishing and Buffing activities to a separate building, allowing space for additional electroplating facilities.

In 1927 funds were made available for the installation of a more modern electroplating plant with particular emphasis being placed on chromium plating, with the idea of chromium plating the bores of major caliber gun barrels. This plant was installed in 1928 and was the first complete electroplating plant established by the Navy. Other electroplating plants have since been installed in other Naval activities from plans, instructions and specifications furnished by the Naval Gun Factory. With the advent of chromium plating many opportunities developed for increasing the life and usefulness of many ordnance details by electroplating areas where excessive wear occurred. Chromium, being hard, of considerable wear resistance and of some corrosion resistance, gave increased life to parts subjected to wear and a combination of wear and corrosion. Techniques have been developed for salvaging worn and mis-machined parts by electroplating them to restore them to size. Materials valued at many thousands of dollars have been salvaged by this method.

Plating Gun Barrels

The first gun barrel was chromium plated in 1928 and from tests it was considered of sufficient value to justify the continuance of chromium plating gun barrels. By 1933 specifications required that all major caliber gun barrels from 3" to 16" be chromium plated throughout the bores. This necessitated the installation of additional equipment and the development of special anodes.

When the technique for plating gun barrels was being planned an effort was made to avoid using any method when plating the initial 5" gun that could not be adapted to the plating of larger guns such as 8" and 16". As the 8" to 16" guns were too large to plate in a tank, it was decided that they should be set up vertically with the breech end sealed, using the gun itself as a container for the electrolyte. This method was used for the 5" inch gun which was selected for the initial test of chromium in gun barrels. With this method of plating, difficulty was experienced in controlling the temperature of the electrolyte by means of a water bath around the gun as considerable heat was created by the passage of a high current through a small amount of electrolyte. A special water cooled anode was developed which consisted of two copper tubes, one placed inside of the other and welded at each end forming a chamber between the outside of the inner tube and the inside of the outer tube. The bottom end of the inner tube was perforated to permit a circulation of water from the inner tube to the chamber between the two tubes. At the upper end of the outer tube there was an overflow pipe. In operation, water connections were made to the upper end of the inner tube; the water circulated down the inner tube through the perforations at the bottom

Official Photograph, U. S. Navy.
Cadmium and Zinc Plating Section.

Official Photograph, U. S. Navy.

Gun Barrel Plating Section.

into the chamber between the two tubes and out of the overflow pipe at the top of the outer tube. During the chromium plating of the gun barrel, the temperature of the electrolyte could be controlled to any desired figure by controlling the amount of water flowing through the anode. This anode was supported centrally and vertically through the bore of the gun. The outside of the anode was coated electrolytically with lead to prevent an attack on the copper by the electrolyte.

This type of anode is used for plating guns up to 6" bore diameter. For guns larger than 6" a progressive or moving type of anode is used. Due to the extremely high total current that would be required to plate the entire bore simultaneously, a fixed or stationary anode is not practicable.

The moving anode used for plating the larger guns consists of an active section of anode 24" long at each end of which is a centralizing and insulating disc perforated to permit the passage of electrolyte and the gases created during deposition. To this anode is attached a bus bar for conducting current to the anode. This bus bar is encased in a steel tube which is insulated from the bus bar and this tube is further encased in a second larger tube forming a chamber between the two tubes. The chamber thus formed is used for the circulation of water to control the electrolyte temperature during deposition. As the end of the bus bar opposite the active anode is a series of electrical contacts, touching bus bars that are fastened to but insulated from a supporting structure. These bus bars are connected to the source of plating current. The anode and tube assembly is suspended in the supporting structure where, with suitable motors and gearing, it can be raised or lowered through the structure and gun at predetermined speeds. While the anode and tube assembly is being raised or lowered there is a sliding electrical contact maintained between the anode bus bar and the stationary bus bars mounted in the supporting structure. The bus bars and sliding contacts are designed to carry 10,000 amperes without undue heating.

In operation the gun is set in a vertical position on its breech end on a sealing gasket in a pit of suitable depth, properly cleaned for electroplating, and filled with the electrolyte at the proper temperature. The anode supporting structure is then set in a vertical position on the upper or muzzle end of the gun so that it can be lowered into the gun bore. By mechanical means the anode is lowered through the bore of the gun to the desired position at the breech where electroplating is to commence. A proper current density is applied and the anode is raised at a suitable speed to give the desired thickness of deposit when the active 24" section of the anode has moved its length through the bore. When the active area of the anode has been raised through the entire length of the bore the operation is complete. Some idea of the problem involved in developing the technique for this type of job can be gained from the fact that the anode and its supporting structure weighs over 25 tons and is over 70' long; the guns weigh up to 250,000 lbs. when assembled for plating, are over 65' long and have over 300 sq. ft. of surface to be plated.

Finishing Equipment

The plating equipment in the Washington Naval Gun Factory for plating gun bores consists of: 1 plating pit, 75' deep; 2 plating pits, 60' deep; 4 plating tanks and 4 cleaning tanks, 36" in diameter and ranging from 10' to 27' deep; 1 lead plating tank, 18" x 18" x 26' long; 1 lead plating tank 30" x 30" x 36" deep (the lead plating tanks are used for plating anodes for gun barrels); 4 electrolyte storage tanks ranging in size from 300 gals. to 900 gals.; 2—10,000-5,000 ampere, 8-16 volt motor-generators; 4—500 ampere, 6 volt rectifiers; 1—500 ampere, 6 volt motor-generator for lead plating; 1—40 ton and 2—135 ton overhead cranes; buffing equipment for buffing the bores and rifling grooves in all major size gun barrels.

Buffing equipment for gun bores was developed by the Washington Naval Gun Factory, and this equipment consists of a mechanical buffing head containing up to 4 buffing wheels so arranged that they revolve parallel to the axis of the gun bore, making it possible to buff the bottoms of the rifling grooves and remove all minor roughness left by the machining and lapping operations.

The electroplating and polishing activities of the Washington Naval Gun Factory are now occupying four separate buildings totaling 35,000 sq. ft. of floor space. One building is used for gun plating, one for polishing and buffing and two for miscellaneous plating. This miscellaneous plating is done mainly on material for Naval Ordnance, but considerable plating is done for other activities and departments of the Government. To accomplish this work the following equipment is available:

14 chromium plating tanks ranging in size from 60 gals. to 1,800 gals.
6 cadmium plating tanks ranging in size from 400 gals to 3,000 gals.
2 zinc plating tanks; 400 and 600 gals.
2 semi-automatic tanks for zinc or cadmium.
4 plating barrels; 2 for cadmium, 1 for zinc and 1 for nickel.
4 nickel plating tanks ranging in size from 100 gals. to 1,800 gals.
1 tin plating tank; 400 gals.
1 50% lead and 50% tin plating tank; 400 gals.
Anodizing and Alumilite process tanks for both sulphuric and chromic acid anodizing. 9 tanks from 50 gals. to 300 gals.
Phosphate surface treatment equipment; 4 tanks 400 gals. ea.
Pentrate process tanks; 6 tanks 100 gals. ea.
3 copper plating tanks; 400 gals. ea.; one acid copper, two alkaline copper.

1 silver plating and 1 strike tank; 60 gals. ea.
1 gold plating tank.
Equipment for special finishes such as oxidizing, coloring, etching, electropolishing, etc.
4 10,000-5,000 ampere, 8-16 volt motor-generator; one is a spare.
1 500 ampere, 50 volt motor-generator.
1 300-150 ampere, 12-24 volt motor-generator.
1 500 ampere, 6 volt motor-generator.
1 100 ampere, 6 volt motor-generator.
1 400 ampere, 25 volt motor-generator.
3 vapor degreasers.
1 1 ton traveling bridge crane.
1 10 ton traveling bridge crane.

There are cleaning, pickling and rinse tanks in sufficient numbers to handle the work done in the above listed equipment.

In the interest of safety and health protection, all of the plating, cleaning and pickling tanks from which poisonous or obnoxious fumes arise are equipped with exhaust slots around the top edge of the tanks, connected through suitable ducts to exhaust fans and stacks. There are 16 exhaust fans used for this purpose, exhausting 120,000 cu. ft. of air per minute. During the winter months this amount of air is replaced in the building by unit heaters that draw the air from the outside, heat and blow it into the building.

All employees working in the Plating shops are furnished when necessary, with rubber gloves, leather gloves, rubber aprons, goggles, prescription lenses, face shields, protective skin lotions and any other equipment required in the interest of safety. They are given a periodic examination by the Naval Medical Officer and complete treatment in case of injury or any ailment caused as a result of their duties.

Finishing Work

The work done in the Plating and Polishing Shops mainly consists of miscellaneous details for ordnance equipment varying in size from small screws and cotter pins to the largest details of ordnance manufactured weighing up to 115 tons, some of which requires special anodes and racks. An example of this has been previously explained in connection with gun plating. Another item that was formerly done and required special equipment for plating were roller paths. These paths were ring type varying in size from 7' to 10' in diameter and were required to be chromium plated on all surfaces. They were first plated on a rack that held the path in a horizontal position in the plating solution on three points of support. The points of support were also the negative current contact to the path and were made on the non-roller bearing surface of the path. During electrolysis the path was revolved periodically to change the points of contact. This method did not give a fully satisfactory product. The plating on the contact points was thin and at times the path was burned due to the arcing of the high current at the points of contact, and the thickness of plate was not uniform across the face of the path. To correct these undesirable conditions, equipment was developed whereby the path was suspended in a vertical position on three supporting rollers with the lower half of the path submerged in the plating solution. Current was supplied to the path by means of a number of small rollers contacting the section of the path that was out of the plating solution. The number of these rollers was sufficient so that no arcing would occur when the current was applied. The path was revolved mechanically through the solution at 1 to 1½ revolutions per minute while sufficiently high current was applied to deposit the desired thickness of plate in the same time required by the old method. The anodes were so arranged that they were adjacent to the faces of the paths, with narrow auxiliary anodes attached that extended to within ⅜ of an inch of the face of the path. These auxiliary anodes were ½" wide as compared to the 2½" wide face of the path. This method gave a very uniform distribution of plate.

Many varied types of racks and anodes had been developed for use in plating ordnance material, some very plain, some rather complex. Some consisted of cathode racks and anodes combined in a single unit; others consisted of cathode racks, internal anodes and external anodes in a single unit, with separate current control to each anode. This was necessary where close tolerances were required on the thickness of deposits on interior as well as exterior surfaces.

A comparison of the output of the Plating and Polishing Shops during war time and peace time operations can be gained from the fact that at the peak of the wartime work load 276 employees were required to meet the Navy's production requirements. This number has, since V-E Day, been reduced to 82.

In the Polishing and Buffing section all the grinding, polishing, buffing and sandblasting required for the finishing of metals is done. There are 19 polishing and buffing lathes, 2 cabinet sandblasts, 2 tumbling barrels, 10 grinding booths, polishing wheel maintenance equipment and numerous portable air and electric grinders. These polishing and buffing lathes, sandblasts and grinding booths are all connected through suitable hoods and ducts to dust exhausting equipment. Fans on this exhaust system are capable of removing 85,000 cu. ft. of air per minute. Work done in this section is in three classes; work of a small nature that can be done on the buffing lathes; work too large to be handled at the lathes but small enough to economically transport to the shop which is done with portable grinding, polishing and buffing equipment in booths from which the grinding dust is exhausted; and work on items of such size that transporting it to the shop is prohibitive which is done at the place of assembly. For this type of work the mechanic goes to the job and performs his work with portable air or electric polishing and buffing equipment. Some of the last two types

Official Photograph, U. S. Navy.
Chromium Plating Section.

of work requires hand grinding and polishing to gage tolerances on such items as shell trays, projectile and powder hoists, breech housings, etc. Some of these weigh many thousands of pounds and cannot be done economically by other means.

Plating Preparation

The preparation of articles for electroplating is done by the usual methods practiced by the trade. The desired finish is obtained by grinding, polishing, buffing or sandblasting. It is then soaked or electrocleaned in alkaline cleaners, rinsed, acid dipped, double rinsed and plated. In some cases, for cadmium and zinc plating, the work is stored in a cyanide solution after cleaning while awaiting racking. After cadmium and zinc plating the work is double rinsed, dipped in a 1% nitric acid neutralizing solution, rinsed, dipped in hot, weak soap water and dried. This is to prevent tarnish from finger stains while being handled through inspection. Cleaning the larger guns is accomplished by placing the gun in a pit in a vertical position on its breach end on a sealing gasket and filling it with cleaner solution. A steam coil is then inserted in the gun and the cleaner is heated to 190° to 200° F. for about one hour. The solution is then drained from the gun and the bore is scoured with cleaner solution and powdered pumice. It is then rinsed and again scoured with a 10% sulphuric acid solution and powdered pumice, and after a thorough rinse, several gallons of chromic acid are poured through the gun to protect the cleaned surface until the gun is filled with the plating solution. The scouring is done with a special mop which consists of several sections of wire brush wheels mounted on the end of a pipe shaft of sufficient length to reach through the gun. The brush wheel sections are slightly larger than the bore of the gun so that when it is drawn through the gun the wire bristles will press into the bottom of the rifling grooves. The wheel sections are covered with several layers of burlap which is saturated with the cleaner or acid solution and lowered and raised successively through the gun while the solution and powdered pumice are allowed to run down the surface of the gun. The mop, weighing several hundred pounds, is raised and lowered through the gun by an overhead crane.

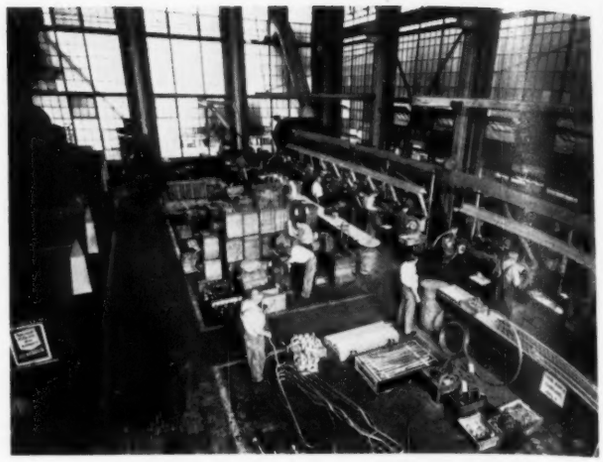
Plating Solutions

All plating solutions are maintained to standard formulas by weekly chemical analysis and additions. When necessary, due to high production in any solutions, more frequent checks are made. No additions, except water to maintain solution level, are permitted except those indicated by analysis. The chemical analysis of the solutions are made in the chemical laboratory where a chemical engineer and a corps of assistants are assigned to this work and to the analysis of all materials used in the plating baths, as well as conducting laboratory research as an aid to solving metal protection and finishing problems.

The formulas and operating conditions of the electroplating solutions used at the Naval Gun Factory are as follows:

Zinc

Zinc Cyanide	8.0 oz. per gal.
Sodium Cyanide	3.0 oz. per gal.
Sodium Hydroxide	10 to 12.0 oz. per gal.
Corn Sugar	1.0 oz. per gal.



Official Photograph, U. S. Navy.

Polishing and Buffing Section.

Temperature	90° F.
Current Density	15 to 75 amps. per sq. ft.

Purified periodically with zinc dust, agitation and filtration.

Neutralizing dip after plating: 1% Nitric Acid.

Anodes—Zinc, containing small amounts of magnesium or calcium to prevent undue chemical solution of the anode.

Rate of deposition: 0.0008" to 0.003" per hour.

Cadmium

Cadmium Oxide	2.3 to 3.4 oz. per gal.
Total Sodium Cyanide	9.0 to 10.0 oz. per gal.
Free Sodium Cyanide	5.0 to 6.0 oz. per gal.
Sodium Hydroxide	0.2 to 1.5 oz. per gal.
Brightener	As required
Current Density	10 to 15 amps. per sq. ft.
Temperature	80° to 90° F.

Anodes—Cadmium sticks in steel baskets.

Rate of deposition: 0.0008" to 0.0012" per hour.

Neutralizing dip after plating: 1% Nitric Acid.

Chromium (Solution A)

Chromic Acid	33.5 to 36.8 oz. per gal.
Sulphate	0.335 to 0.368 oz. per gal.
Current Densities	150 to 500 amps. per sq. ft.
Temperatures	120° to 145° F.

Rate of deposition: 0.0003" to 0.0015" per hour.

When plating the interior of gun barrels at the higher current densities with Solution A, slightly nodular deposits similar to those obtained from solutions with insufficient sulphate have been encountered. The nodule formation seems to be characteristic of plating in a confined space with violent gas evolution and under these conditions it has been found necessary to increase the sulphate concentration (Solution B).

Chromium (Solution B)

Chromic Acid	33.5 to 36.8 oz. per gal.
Sulphate	0.40 to 0.42 oz. per gal.

Tin

Sodium Stannate	12.0 oz. per gal.
Caustic Soda	2.0 to 3.0 oz. per gal.
Sodium Acetate	2.0 oz. per gal.

Hydrogen Peroxide (100 vol); or

Sodium Perborate	1/16 oz. per gal.
Cathode Current Density	6 to 60 amps. per sq. ft.
Anode Current Density	5 to 25 amps. per sq. ft.
Temperature	140° to 176° F.

For satisfactory operations the anode current density is important. It has no fixed value but varies directly with the temperature of the solution and the free caustic soda and tin content of the bath. When proper balance is obtained the anodes become covered with a greenish yellow film. This condition of operation is critical and will vary with each bath. When the solution is properly maintained and operated, deposition should be at the rate of 0.000057" per ampere hour per sq. ft.

Immersion Tin for Brass or Copper

Stannous Chloride	0.67 oz. per gal.
Sodium Hydroxide	1.69 oz. per gal.
Sodium Cyanide	16.0 oz. per gal.
Temperature	60° to 90° F.
Coating Time: ¼ to 10 minutes	
Coating Thickness: 0.00003" to 0.00008"	

Lead Fluoborate Solution

Basic Lead Carbonate	20 oz. per gal.
50% Hydrofluoric Acid	32.0 oz. per gal.
Boric Acid	14.0 oz. per gal.
Glue	0.025 oz. per gal.
Temperature	70° to 80° F.
Current Densities	9 to 19 amps. per sq. ft.

Lead 50%, Tin 50%

Lead-tin fluoborate solutions are made by electrolyzing at 10 amps. per sq. ft. a standard lead fluoborate solution using pure tin anodes and "dummy" cathodes until the equilibrium solution for depositing the alloy is reached. For depositing a 50% lead 50% tin alloy, the final solution should contain approximately 2.63 oz. per gal. of lead and 6.45 oz. per gal. of tin. Frequent stirring of the solution while electrolyzing is necessary. After electrolyzing, tin anodes and "dummy" cathodes are removed, and the solution filtered if it is not clear.

In operation, it is customary to use lead-tin anodes containing 45% tin-55% lead; current density of 4.7 to 14.0 amps. per sq. ft. at room temperature.

Copper Cyanide Solution

Copper Cyanide	6.0 oz. per gal.
Sodium Cyanide	7.6 oz. per gal.
Sodium Carbonate	2.0 oz. per gal.
Copper Content	4.3 oz. per gal.
Free Cyanide	0.9 to 1.0 oz. per gal.
Temperature	100° to 120° F.
Current Density	10 to 20 amps. per sq. ft.
Rolled Copper Anodes	

Acid Copper Solution

Copper Sulphate	27.0 oz. per gal.
Sulphuric Acid	6.5 oz. per gal.
Temperature	77° to 122° F.
Current Density	19.0 to 37.0 amps. per sq. ft.
Rolled Copper Anodes	

Nickel

Nickel Sulphate	27.0 oz. per gal.
Nickel Chloride	6.0 oz. per gal.
Boric Acid	4.0 oz. per gal.
pH—5.3 (Glass Electrode).	
Temperature	122° to 140° F.
Current Density	14 to 47 amps. per sq. ft.
Rolled 99 + % Nickel Anodes.	

Silver (Strike)

Metallic Silver	0.61 troy oz. per gal.
As Silver Cyanide	0.79 troy oz. per gal.
Potassium Cyanide	9.0 oz. per gal.
Anodes—Annealed, rolled, 999 fine silver.	
Temperature	70° to 80° F.
Current Density	10 to 15 amps. per sq. ft.

Silver

Metallic Silver	3.5 troy oz. per gal.
As Silver Cyanide	4.4 troy oz. per gal.
Total Potassium Cyanide	5.0 oz. per gal.
Free Potassium Cyanide	2.5 oz. per gal.
Potassium Carbonate	5.0 oz. per gal.
Anodes—Annealed, rolled, 999 fine silver.	
Temperature	70° to 90° F.
Current Density	2.75 to 9.0 amps. per sq. ft.
(C.D. depending on the free cyanide and carbonate content).	

Gold

Metallic Gold as Fulminate	.34 oz. per gal.
Potassium Cyanide	2.00 oz. per gal.
Anodes—24 Karat Rolled Gold.	
Temperature	140° to 176° F.
Current Densities	1.00 to 5.00 amps. per sq. ft.

The higher current densities are used at the higher temperatures. This solution is used for depositing high purity gold on electrical contacts where the minimum of electrical contact resistance is desired. It has been found that the gold as deposited, with a soft matte finish, has less contact resistance than when burnished.

Cadmium Strip

Cadmium is stripped from plating racks and defective products in a solution containing 8 to 16 oz. per gal. of ammonium nitrate. Because of the scarcity of cadmium, the cadmium is salvaged from the strip solution in the following manner:

The strip solution, when it has become nearly saturated with cadmium, is transferred to a clean steel tank equipped with steam coils. Sodium hydroxide is added to the strip in sufficient quantity to precipitate the cadmium as cadmium hydroxide. The amount of sodium hydroxide required is roughly 1.5 oz. for each oz. of cadmium in the strip. After adding the sodium hydroxide, the solution is stirred thoroughly to make sure that it is all dissolved. To test the solution for unprecipitated cadmium, a small amount of sodium hydroxide is added to a sample of the strip. If

(*Concluded on page* 478)

WATER AND ELECTRODEPOSITION

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A comparison is made of the impurities tolerated by various electroplating solutions and those introduced by regular tap water. The need for fundamental data on the effect of impurities as to type and property of plate is pointed out. Water, the principal constituent of cleaning solutions, plating solutions, and rinsing solutions can be controlled by demineralizing—a control which can be obtained easily and cheaply.

SUCCESSFUL commercial electroplating depends on a number of factors. Only factors which are of a technical nature will be considered in this article. A satisfactory plate—bright, adherent, tarnish resistant, corrosion resistant, etc.—depends on the preparation of the surface to be plated and on appropriate control of the plating solution—current density, voltage, impurities in the anodes and in the salts used, pH, temperature, contamination from plating tanks and racks, addition agents—dust in the air, and others. However, water, the constituent present to the greatest extent in cleaning solutions and in plating solutions, the substance invariably used for rinsing, is given very little thought and generally is not controlled.

It has been pointed out[1, 2, 3] that if impurity-free water were used in the makeup of aqueous cleaning solutions, many problems could be avoided in cleaning and in rinsing. Hogaboom and others[4, 5, 6, 7] have issued a similar warning to the electroplater. A discussion of the impurities found in plating solutions and in water, and methods of their removal should be of interest.

Impurities found in the plating solution may be present in either a dissolved or suspended state. The suspended impurities are eliminated mostly by filtration. The dissolved impurities which may be inorganic or organic may be removed by:

1. Precipitation—change of pH or change of temperature.
2. Oxidation.
3. Electrolysis.
4. Use of activated carbon to remove organic material by adsorption[8].

Generally suspended impurities cause porosity, roughness and treeing of deposits.

In Table I the effect of various impurities in several common electroplating solutions is shown. The limiting amount of impurity allowable is indicated. It is to be noted that frequently very small amounts of a constituent in a bath have a decided effect. For example, it was found, in an investigation of addition agents for the brightening of zinc sulfate plating solutions,[9] that there were definite limits where the addition was beneficial. Amounts above the upper limit often proved detrimental. A 0.1 ppm. solution of germanium stops completely the deposition of zinc on steel.[10]

TABLE I

Classification of Impurities in Plating Baths

	1. Dangerous					2. Lowers Plating Efficiency	3. Attack of Anodes	4. Beneficial Impurities
Bath	a) Impair Purity of Cathode	b) Embrittlement or Greater Hardness of Deposit	c) Rough Deposit Treeing Nodules, etc.	d) Banded Deposits Pitted	e) Corrosion Resistance			
$Zn\text{-}SO_4$	Fe-10; Co 1.	Ni-1, Cd-10.	Pb,Mn 350,Ca 700			Cu-.1, As<.1, Sb-.2; Ge-.05	Cl<1	Al, Ag, Hg, W, Mo
Ni		$CO_3^=$ NH_3 Fe, Cr^{+++}	$Cu^=$	Cu-.006		Fe		Mg,
$Zn(CN)_2$		$CO_3^=$				Cl^-		
Cu			Fe					
Cyanide						$CO_3^=$, SiO_2		
Co			As - >.001					
Bright Ag		CS_2* - >.75						

* Added as addition Agent.

TABLE II

Impurities Which May Be in Water

A. *In Solution*				B. *In Suspension*
I. *Inorganic*				
Cations		*Anions*		
Hydrogen		Bicarbonates	982 ppm	Clay
Ammonium		Carbonates		Colloidal matter
Aluminum		Chlorides	552 ppm	a) Inorganic—silica
				b) Organic—Albumen
Calcium	210 ppm	Fluorides	1 ppm	Dirt
Copper		Nitrate	57 ppm	Rust
Iron (+Al)	51 ppm	Nitrate	66 ppm	Silt
Magnesium				Phosphate
Manganese	4 ppm	Silicates as SiO_2	82 ppm	
Potassium	52 ppm	Sulfates	1,199 ppm	
Sodium	322 ppm	Sulfides		
		Sulfites		
II: *Organic*				
		Salts—Acids		

Notes: 1. The impurity is expressed in ppm of the ion. 2. Values given are maximum found in latest published survey of U. S. Waters.[14] The maximum total solids found may be over 1800 ppm. Surface waters may contain a high percentage of organic matter.

Some data are available in the literature on this subject,[11] although the need for systematization and for more of such information is great. The problem of impurities in plating solutions is not only critical to the decorative electroplater, but also to the industrial electrometallurgist. Deposited impurities on copper cathodes are undesirable, and impurities in the various metal powders produced electrolytically for the powder metallurgist are restricted.

It would be desirable for complete tables similar to the one suggested to be made for other common plating baths. It is possible, however, that the data available are not conclusive because all the proper precautions were not taken in running the experiments.

The problem of impurities in industrial electrolytes was discussed by Liddell some twenty years ago[12]. "The problem of electrolytic contamination is not alone a concern of the electrometallurgist. In general, it may be said that what is the greatest concern of the commercial operator is usually the smallest worry of the amateur experimenter."

A summary discussion of the impurities introduced into the plating bath is in order. The impurities from added salts is covered in many instances by specifications. The same is also true for the impurities from soluble anodes. If the bath is properly operated no impurities or only a small amount would be introduced from insoluble anodes. Organic coatings resistant to the plating bath and its operating conditions are necessary for racks. Proper control and choice must also be exercised in the case of tank linings. Occasionally it is possible to prevent corrosion of bus bars. Bus bars over chromium plating baths may be tinned. Ventilators, etc. may be protected with rubber or protective coatings. Purification of plating solutions may be carried out by one of the methods already mentioned.[13]

Most plating baths are of the aqueous type, and therefore water makes up the great bulk of the solution. In most aqueous plating solutions 70 to 90% per weight of material is water. Water is lost by evaporation when heating. Water is "dragged in" on the material to be plated from the last rinse. Plating solution is removed by "drag out."

Hogaboom,[4] a few years ago, discussed the subject of water in the plating room. He raised several questions on the effect on plating of actual impurities in the water. Summarily:

1. May the "carbonate" in cyanide baths not come partially from carbonate hard waters?
2. In bright nickel plating solutions, may the precipitate or neutralization found at the cathode, not be caused by the accumulation of salts coming in with the rinse water?
3. How often is the water in the final rinse tank changed?
4. How often does the electroplater think of the water he is using?

We come to the conclusion that the big unsolved problem of the plating room is water.

"Drag in" has been ably discussed by Kushner[15] and several mathematical relationships developed which show how water impurities may build up in the plating bath, under the following conditions:

(a) when no evaporation occurs
(b) when the evaporating water is constantly being replenished
(c) when the evaporating water is intermittently replenished.

The effect of water impurities upon nickel deposits,[16] as well as on gold plating,[15] have been discussed in the technical literature.

Some years ago the writer operated a pilot-plant-scale wire electrogalvanizing unit. The importance of the water making up the plating solution and of the water used in the final rinse prior to plating was forcibly brought to his attention. The ordinary water supply (200 ppm.) as $CaCO_3$ caused dif-

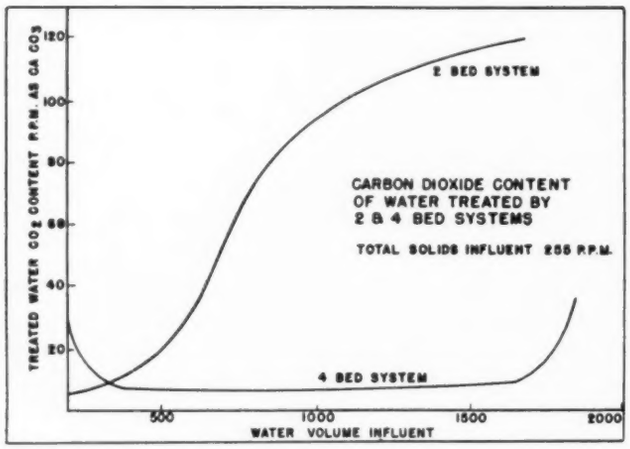

Fig. 1

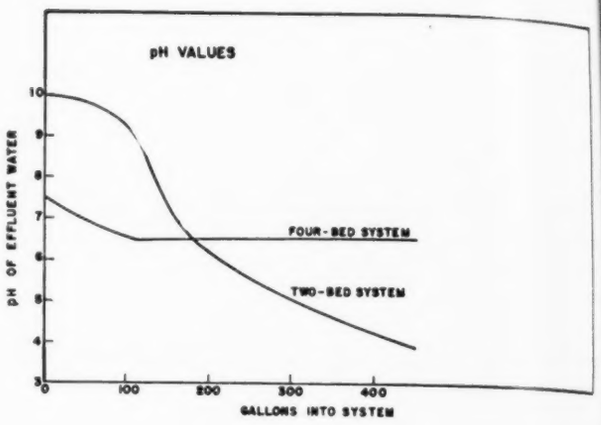

Fig. 2

ficulties which were not present in beaker experiments, where solutions were made up with distilled water. It finally was necessary to use distilled water in the pilot plant for four purposes in order to obtain consistently good results:

1. Water rinse prior to electroplating—"drag in"
2. Make up plating solution
3. Replenish loss by "drag out"
4. Replenish water in plating solution lost by evaporation.

Plating efficiency is closely related with the pretreatment of metals, the last operation of which is rinsing. Blistering, poor adhesion, tarnished and possibly spotty deposits may be directly attributed to a disregard of this step in the sequence of plating operations. The effect of water on cleaners and the required rinsing properties have been discussed.[1, 2, 3]

The water technologist has a language of his own.[2] For example, he talks about temporary hardness, permanent hardness, and total hardness. He expresses the amounts of the various compounds present in ppm (parts per million) or in gpg (grains per gallon) where 10 gpg = 171 ppm = 0.0171% of the total composition.

The impurities found in water may be classified as shown in Table II.

The amount of the impurities in water compared with the allowable percentage of impurities in certain plating solutions may come as a shock to many platers in view of the fact that water, if drinkable, is considered all right for electroplating. Many difficulties encountered, may likely be due ultimately to the water used. What can be done about water? Oplinger[17] wrote: "The use of soft water for plating solutions becomes more important as time goes on."

Today, demineralized water, in solids content as low as distilled water, can be made available as readily, and nearly as cheaply, as ordinary tap water without distillation. The process is almost as simple as filtration. The materials used to demineralize water are certain synthetic resins having remarkable ion-exchange characteristics.

The ion-exchange resins are of two types—one is a cation active material, and the second is an anion active material. Water containing sodium chloride (common table salt), for example, is filtered through a bed of hydrogen activated cation resin; the resin takes sodium to form sodium resin and gives up its hydrogen to the chloride to form hydrogen chloride. The water containing the latter then flows on through an anion resin bed where the hydrogen chloride is absorbed by the resin, and water free of sodium chloride results. By analogous reactions, the same resins will strip water of any mineral salt.

When the ion-exchange resins are exhausted, they are easily reactivated by simply passing a dilute acid solution through the bed of cation resin and a weak alkali through the anion bed, an easy procedure which can be provided for in the apparatus. Ultimate replacement with new resins is due only at long intervals; some units have been in steady use without renewal for many years.

A system of cation and anion exchange resins is called a two bed system. Figures 1 and 2 indicate the removal of CO_2 and the pH by such a system. A disadvantage of this system is leakage of ions, lack of pH control and presence of CO_2 in the effluent.

To push the exchange characteristics of the ion-exchange resins to the point of greatest efficiency, the four-bed system

Fig. 3

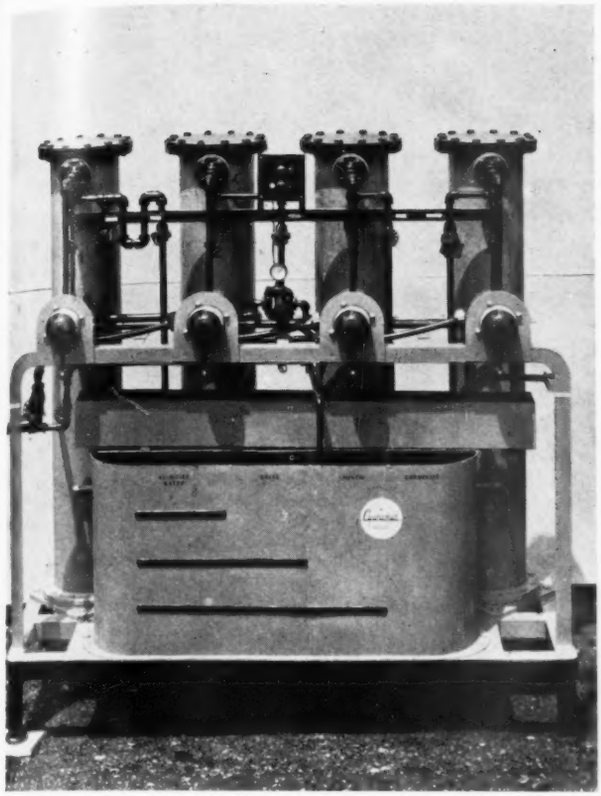

Fig. 4

has been developed, whereby the influent flows successively through cation, anion, cation and anion resin beds. Water-treating engineers evaluate the quality of water by determining its electrical resistance, since the lower the solids content of water, the greater is its resistance to the flow of electricity. For example, a certain raw water had a specific resistance of 3,000 ohms. After passage through a single cation and a single anion resin bed, it had a resistance of 70,000 ohms and when demineralized by the four-bed system, its resistance rose to 1,500,000 ohms; its solids content had been reduced from the original 346 parts per million to 2 parts per million! This is a degree of demineralization more than adequate even for exacting experimental work in laboratories. In all types a conductivity cell, keeping watch over the resistance of the effluent, actuates a signal light or an automatic shutoff so that only water of the desired purity will be drawn off.

Equipment is available commercially, in units having a flow rate of 10 gallons per hour (Fig. 3) ranging upward to larger (Fig. 4) especially constructed units, having a flow rate in excess of 100,000 gallons per hour. Several demineralizing units are already in operation in the mirror silvering industry. The finished product has improved in quality and production "headaches" have been minimized by the use of demineralized water.

Plating experiments have been made on copper cyanide baths using regular tap water and demineralized water by a manufacturer of plating solutions. The solutions made up with the latter gave brighter deposits, comparing favorably with "bright" copper plate.

It should be emphasized that the application of resins to the electroplating field is just in its infancy. Recently[18] it has been suggested as a research tool in the field of electrodeposition. The following uses have been suggested to the electroplater.

a) Recovery of Ag from spent Ag solutions and rinse waters.

b) Control of the pH of plating solutions, as for example nickel plating solutions operated with insoluble anodes.

c) Removal of Na_2CO_3 from cyanide-type baths.

d) Metal recovery by anion exchange—Au, Cr, Mo, Pd, Pt, V and Mo[19].

In conclusion, not so many years ago the plating shop was a dirty, out-of-the-way corner in the plant. At present they are clean, well-lighted, well-ventilated and, in certain cases, dust-free. The shovel to throw chemicals into the bath has been exchanged for a scale. Salts and anodes are bought according to specifications. The electroplater makes good use of chemical analysis and frequently controls his solutions with pH meters. We all are surprised when the electrochemist in the laboratory, using distilled water, gets different results than the plater in his shop, using tap water. An attempt has been made in this article to show the relationship between water, impurities and electroplating. Water makes up approximately 80% by weight of most plating solutions. The electroplater may soon have to do something about water to obtain uniform results throughout the country to meet specifications. How to go about it is no mystery! DEMINERALIZE THE WATER.

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Properties of the Plate

CONCLUSION

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Physical Properties

DATA on hardness, tensile strength or elasticity of a deposit is seldom required; however, in engineering applications either hardness or heat treatment to produce a certain hardness range may be specified. For this reason it is desirable to study the physical properties of the plate during the investigation of a new plating bath. These may then be correlated with the bath characteristics. It may further be desirable to measure the change in phyiscal properties on annealing in order to specify the annealing practice.

Figure 5 illustrates how hardness and tensile strength decrease upon increasing the annealing temperature and also how a specimen will elongate (under an applied load) to a greater extent after treatment at higher temperatures. The elongation is a measure of ductility.

Experimentally, tensile strength may be used as a substitute for hardness since the properties are parallel. The choice of measurement depends on the metal and the relative difficulty of producing appropriate specimens for the test chosen.

Tensile Strength

A specimen for tensile strength may be prepared by depositing the metal on a base from which it can be readily stripped. Polished steel, stainless steel or chromium are the commoner bases used for this purpose. After the metal is stripped, it is then cut into an appropriate shape for testing.[10] The test is readily made in a standard machine which essentially consists of clamping devices to hold the specimen in position, a means of applying an increasing force until the specimen ruptures and an indicator to show the load applied. The tensile strength of many of the commonly plated metals can be readily measured by this method.

Hardness

Tensile strength measurements are preferred over direct hardness measurements, providing the tensile strength can readily be determined, as there is not as much doubt of the meaning of the results as there is of hardness tests. If hardness is measured, it is necessary to specify the method to be used, the load to be applied and the minimum thickness of the specimen. With the proper equipment, hardness may be reproducibly measured on specimens as thin as one mil. But most standard equipment requires much thicker specimens to avoid errors due to the effect of the basis metal. Even then the hardness of a thick deposit may only be an indication of the hardness of thinner deposits since the first layers deposited may be of finer grain size. However if the metal is to be annealed, then the hardness is likely to be the same throughout. Most of the hardness tests are relatively simple to run after the specimen is prepared but to compare the results of one worker against another the same method, the same type of machine, the same type and size of indentor and the same load should be used. The best alternative to this is a conversion scale from one type of hardness scale to another which is prepared by testing the same specimens by both methods. The specimens should be alike in all respects to those to be measured.

Wear

Hardness may often be measured as an indication of the expected life of a plated part under service conditions. It is however only an indication, providing the effect of hardness on service life is known.

If the service conditions primarily produce wear on the part, then a wear test should be run since hardness and wear may not correlate. The best wear test is of course the actual service condition but as this cannot be done in a majority of cases a machine such as the Taber Abraser may be used.[11]

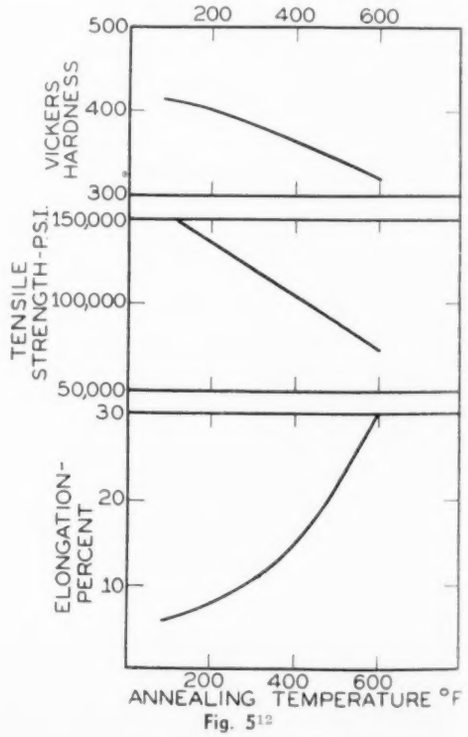

Fig. 5[12]

This type abraser is designed to measure the rate of wear of surface finishes subjected to rubbing abrasion. It consists of two abrasive wheels, under a definite load, which revolve in opposite directions through frictional contact with the rotating specimen and exert a combined abrasive, compressive and twisting action twice in each revolution of the specimen holder. The wear rate is determined either by depth of penetration or loss in weight over a certain number of wear cycles.

Ductility

An electrodeposit is often given a crude test by twisting, bending, pounding or stretching the plated part. As a result of such a test the deposit may blister, peel or crack. If the deposit blisters or peels the adhesion is poor. If the adhesion is good, but the deposit shows a series of cracks after such a treatment then the test is a measure of ductility.

Ductility is the capability of a metal to be permanently deformed or distorted without rupturing. If plated parts are to be formed, crimped, flanged, bent or drawn during a manufacturing process then the requirements are for high ductility. Hardness measurements may be used as an indication of ductility since soft metals may be regarded as ductile and hard metals regarded as brittle. Lead and tin are typical examples of ductile metals whereas antimony is an example of a brittle metal. We cannot, however, simply classify metals as ductile or brittle unless we specify the conditions under which they are prepared. For, as we have seen, a metal may be soft or hard depending on the method of preparation and subsequent mechanical or thermal treatment.

Chromium or nickel may be deposited under conditions that will result in a ductile plate or they may be deposited under conditions that will cause the plate to crack on bending. Copper and even lead, by the use of excessive amounts of addition agent in the plating bath, may be produced as brittle deposits.

Annealing practices are followed to increase the ductility of any of the more commonly plated metals.

Adhesion

The adhesion of an electrodeposit to the basis metal may be tested in a variety of ways including the tests used for ductility. Adhesion, however, is a definite property that can be measured in terms of pounds per square inch necessary to separate the deposit from the underlying metal. Where a bending or twisting test is used the thickness of the deposit greatly influences the test. If the deposit is very thin, of the order of 0.0001 to 0.001 inch, the deposit may be brittle and poorly adherent and yet withstand considerable bending. If a deposit prepared under the same conditions is 0.01 inch or greater it may readily fail on bending. It therefore follows that conditions necessary to produce good adhesion are more readily determined by preparing thick specimens.

In many cases it is not difficult to define good adhesion since the bond between the plate and the basis metal is often stronger than the weaker of the two metals. For instance, if lead is deposited on steel and it is known that the tensile strength of lead under the conditions used is 3,000 pounds per square inch and if it is found that it takes a tensile force of 3,000 pounds per square inch to separate the lead from the steel, then the bond is at least as strong as the lead. On examination of such a specimen after failure it will be found that failure occurred in the lead layer and that some lead still adheres to the steel.

A quantitative test of this type is ideal for development of cleaning and pickling practice prior to plating but it has the disadvantage of requiring thick deposits that cannot always be prepared due to limitations in thickness of deposits (from some of the plating baths). In addition it requires special equipment and can seldom be used for quality control since most deposits are thin.

For most cases then it is necessary to resort to a qualitative test to determine adhesion.

Thickness

The thickness of a deposit affects the apparent physical properties. A very thin deposit appears to be more ductile than a heavier deposit just as very thin strands of brittle glass have properties such that they can be woven into cloth. The apparent hardness of a thin deposit is difficult to measure because the underlying metal affects the measurement. The apparent adhesion of thin plates is greater than for thicker deposits, due to the fact that on deforming a thin deposit has such low total strength that it tends to follow the movement of the basis metal; whereas a thicker deposit will resist the tendency to move it.

In addition to the apparent difference in physical properties of thin and thick deposits there are real differences due to changes in structure as the deposit grows. The first layers of metal deposited are usually of finer crystal size than subsequent layers so that the physical properties change as the plate thickness increases. It is well known that a cyanide copper bath will form a rough deposit for thicknesses greater than 3 mils and it is obvious that such a rough deposit does not have the properties of thin deposits.

Corrosion Resistance

For thin deposits the minimum thickness on significant surfaces is usually specified to insure sufficient life of the plated part. The life of the part depends on the rate of removal of the deposit due to the combined effects of wear and corrosion. Let us take a door-knob as an example. The major factor determining the life of the part on the inside of the house may be wear but the mate on the outside of the same door exposed to weathering is limited in life due to wear plus corrosion brought about by outside exposure. The best method of testing the life of a door-knob is to test it in actual service but this unfortunately is a slow process as the desired life may be twenty years. The next best method depends on the ability of the laboratory man to devise a rapid test indicating relative life of various thicknesses and types of plated surfaces. What type of test would determine the wearing effect of the human hand, plus summer heat and humidity, plus winter ice and cold, plus spring rains? Certainly a salt spray test would not measure all these effects. Although if the door-knob were to be used for a cottage near the sea, it might be a measure of one factor. A humidity cabinet might be set for conditions to measure expected corrosion during certain times of the year but then again it would not be justifiable to say that so many days in a humidity cabinet equals one year of service. Perhaps the door-knob manufacturers have the answer to this question but it is likely that a minimum thickness of plate

is required based on the knowledge of life of door-knobs put into service years ago.

Reproducible corrosion tests are not easily run and the interpretation of data in terms of expected life is often so difficult that considerable effort on the part of the laboratory man is likely to yield only indefinite conclusions. The customer usually solves the problem by deciding how much protection he requires in terms of thickness or in terms of salt spray life. He then sets specifications, taking the responsibility of guessing minimum life for the specifications, based on known results of parts in actual service.

If a deposit is to be used in a container for a corrosive liquid then the obvious thing to do is to suspend specimens in such a liquid and determine the degree of attack on the deposit either visually or by loss in weight. If the specifications require that a plated container have a life of four years then an accelerated test may be developed utilizing more corrosive solutions or using elevated temperatures. However, there is always the danger that a different reaction will take place in an accelerated test than in an actual service test.

Relative corrosion rates may be determined by running a standard specimen along with prepared specimens. For instance, specimens of different thicknesses of zinc, lead, tin and copper may be deposited on steel and brass and all may be run at the same time in a salt spray. It may then be said that a given thickness of zinc is equivalent to a determined thickness of lead, tin or copper in terms of salt spray life. This type of direct comparison test is often used but it must be kept in mind that resistance to salt spray is being measured and the life of a container for oils or chemicals cannot be predicted from such a test.

It is certain that much work remains to be done on corrosion and corrosion test interpretation.

Porosity

Corrosion of the basis metal often takes place because the deposit is porous.

Electrodeposited metals may be divided into two general classes. 1. Those which tend to corrode in the presence of the basis metal because they are electropositive, and 2. Those in which the basis metal tends to corrode because they are electronegative.

If a deposit is electropositive it will protect the basis metal because of the deposit's anodic characteristics; and small pores in the deposit will be of no consequence. If, on the other hand, the deposit is electronegative so that the basis metal is anodic, then pores or cracks in the deposit should be kept at a minimum since the basis metal will corrode readily.

It is usually true that the thicker the deposit the less will be the number of pores penetrating completely to the basis metal. Consequently, the better the protection of the basis material by the deposit. However, in the case of chromium the attack on the basis metal may increase with increase in thickness of the deposit. Thicker deposits crack more readily than thin ones due to internal stress. Still thicker chromium deposits may decrease in apparent porosity, by test, since the initial cracks may be covered by a heavy deposit. New cracks appear at different locations, so that the cracks in the initial plate are covered over.

If the basis metal is protected by selective corrosion of the deposit (as in galvanized steel exposed to weathering) then porosity is not as important as thickness.

The life of the part will depend on the amount of protective metal present. If, the basis metal is protected by effective coverage, then the life of the part will depend on the number of pores, since each pore is a starting point of failure. In general the number of pores will decrease with increased thickness of deposit but it cannot be assumed that a given thickness will guarantee the same degree of porosity. Porosity, in addition to depending on thickness, depends on other factors such as preparation of the basis metal, surface finish prior to plating and the condition of the bath during plating. This means that in order to guarantee protection for a given application the porosity must be measured by one of the standard porosity tests.

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ELECTROPLATING, POLISHING AND BUFFING

(*Concluded from page* 471)

further precipitation takes place, more sodium hydroxide is added to the strip until, by test, no further precipitation takes place. Some ammonia is usually evolved on the addition of sodium hydroxide, so provisions are made to exhaust the ammonia fumes.

After all of the cadmium has been precipitated to cadmium hydroxide, it is allowed to settle. The clear solution above this precipitate is then siphoned off and replaced by an equal amount of clean water. The resultant solution is thoroughly stirred to wash the precipitate, and after settling, the clear solution is again siphoned off. This washing procedure is repeated five times to assure the removal of impurities such as sodium hydroxide, nitrates and ammonia.

After the washing operations are completed the precipitate is dried to a paste by means of the steam coils in the tank, care being taken to avoid drying to a hard cake, because it is difficult to remove from the tank. The resultant paste is stored in earthenware crocks and when needed, is added to the plating baths to replenish the metal content. It is first analyzed to determine the cadmium content as a basis for calculating additions. The paste is dissolved in sodium cyanide solution before adding it to the baths, care being taken to avoid using an excess of the cyanide.

Experience has shown that after adding this cadmium hydroxide paste to the plating bath, the deposit is less bright for about an hour or so, making it sometimes necessary to add a small amount of brightener. During the past few years many hundreds of pounds of cadmium have been salvaged in this manner.

Modified Chromic Acid Anodizing Process for Aluminum

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A wartime shortage of chromic acid made necessary a study of chromic acid anodizing by a process in which bath maintenance is achieved by sulfuric acid additions. The sulfate content of such baths introduces corrosion difficulties when steel tanks are used. However, with protected tanks and carbon cathodes and by controlling the operation on the basis of anode current density, the process appears from the laboratory test to offer promise of a considerable saving in chromic acid consumption. The relations between current density, voltage, sulfate content, and coating weight are described.

ANODIZING aluminum by the chromic acid process is well known and has been fully described in the literature.[2, 3, 4, 8, 9] Briefly, it is accomplished by electrolysis at 40 volts in a 5 to 10% chromic acid solution at 95° F. (35° C.), the aluminum being the anode with the steel tank acting as cathode. Chromic acid is consumed in the process by reaction with part of the aluminum oxide that forms on the aluminum anode. Edwards and Keller[7] showed that only about half the aluminum oxide formed by electrolysis remains on the aluminum surface as the oxide film. The remainder dissolves in the bath and neutralizes chromic acid. It is generally agreed that this accounts for the greater part of the chromic acid loss.

Some chromic acid is also reduced electrolytically to trivalent chromium at the cathode,[5] accounting for an additional but relatively small loss in free chromic acid. Spray and drag-out losses are considerable, and methods for minimizing them were suggested in Conservation Bulletin 16, issued by the Operating Committee on Aircraft Materials Conservation,[1] in which it was also reported that over 90% of the chromic acid consumed in anodizing baths is used to neutralize the dissolved alumina and to maintain proper pH.

Decrease in anodizing activity of the bath is evidenced by an increase in pH and a decrease in current flow at 40 volts. According to one maintenance procedure, periodic additions of chromic acid are made to replace the losses. This results in building up the total chromium content of the bath, and the entire bath must be discarded when satisfactory oxide coatings are no longer produced. Another common maintenance procedure consists of periodically drawing off a portion of the used solution and replacing it with fresh chromic acid solution. This tends to keep the total chromium content constant and the pH in the desired range. In either case, considerable amounts of chromic acid are consumed.

A War Production Board survey indicated that supplies of chromic acid were limited and that, whenever possible, conservation measures should be taken to extend the supply for essential uses. The anodizing of aluminum alloy aircraft parts is an important application accounting for the consumption of large quantities of chromic acid.

A modification of the conventional procedure, involving the use of sulfuric acid instead of chromic acid for rejuvenation of the bath, has been used at the Naval Air Station at San Diego, Calif. The station reported to the Project Committee that the method was successful in markedly reducing chromic acid consumption with improved control of the coating quality. Relatively small additions of sulfuric acid required to keep the anode current density within a specified range. Oxide coatings having substantially the same characteristics as those produced in a straight chromic acid bath were obtained.

When the process was used in trial runs at two aircraft plants, corrosion of the steel tanks and heating coils was encountered. It was felt that additional information was needed on the corrosion characteristics and other phases of the modified process. A laboratory investigation, therefore, was conducted for the Office of Production Research and Development, War Production Board, under the supervision of the War Metallurgy Committee of the National Research Council. Some of the more significant results that were obtained in that "restricted" investigation are reported here.

A stock solution was made up to contain approximately the same proportions of chromic acid and aluminum that might be present in a used commercial bath. Sufficient freshly prepared aluminum hydroxide was dissolved in a solution containing 100 grams per liter of chromic acid to increase the pH to about 1.0. Chemical analysis showed the composition of this solution (in grams per liter) to be: total Cr^{+6} 50.3, Cr^{+3} 0.3, Al_2O_3 14.8, SO_4^{--} 4.7. The presence of 4.7 grams per liter of sulfate is an indication that the gelatinous aluminum hydroxide was not washed completely free of sulfate. Test baths were prepared by adding different quantities of aluminum sulfate to portions of the stock solution; this procedure approximates the composition of baths that have been operated for various intervals and maintained by sulfuric acid additions.

Experiments designed to obtain information on the corrosion of steel cathodes, control of the solutions, and anodizing characteristics of aluminum alloys were conducted in 3.5 liter glass battery jars, immersed in a water bath

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controlled to maintain the temperature in the jars at 95° ± 1° F. (35° ± 0.6° C.). The pH measurements were made with a Leeds & Northrup glass-electrode meter, calibrated against solutions of known free chromic acid content. The weights of the anodic coatings were determined by difference in specimen weights, before and after stripping, in a bath containing 20 grams of chromic acid and 35 ml. of 85% phosphoric acid in 1 liter of water as described in the literature.[6, 9]

Corrosion of Steel Cathodes

Exploratory tests verified that corrosion of steel cathodes was likely to occur in chromic acid anodizing baths containing sulfuric acid. The results were erratic and indicated that various types of behavior might be expected, depending on the cathode current density, bath sulfate content, agitation, and possibly other factors.

To show the effect of cathode current density, four baths having the following composition were prepared:

Bath No.	1	2	3	4
	Grams per Liter			
Cr^{+6}	50.3	50.0	48.7	48.5
Cr^{+3}	0.3	0.1	0.3	0.3
CO_3^{--}	4.7	19.2	33.1	47.1
Al_2O_3	14.8	19.8	24.2	29.0

Several sizes of steel cathodes were electrolyzed in these baths; the anodes were 24S-T or 2S aluminum alloy to give a range of current densities at 40 volts, which is the voltage normally used in commercial work. The tests were carried out at cathode current densities ranging from 0.8 to 186 amperes per square foot in 10% total chromic acid baths containing from about 7.5 to 112.5 grams per liter of sulfate. The baths were adjusted to pH 1.0 with sulfuric acid at the start of each run. The pH increased so rapidly during these runs because of the large quantities of iron dissolved by the acid, that the sulfate content of the baths was doubled or trebled before the tests were completed. Therefore, direct comparisons at constant sulfate content were not always possible. However, it was possible through examination of the surface appearance of the steel specimens and weight loss determinations to divide the specimens into three groups, each representing a characteristic type of behavior. The results may be summarized as follows:

GROUP 1. Cathode current density below 1.0 ampere per square foot. No attack observed at sulfate contents up to about 60 grams per liter. Above that, mild etching occurred at the solution line.

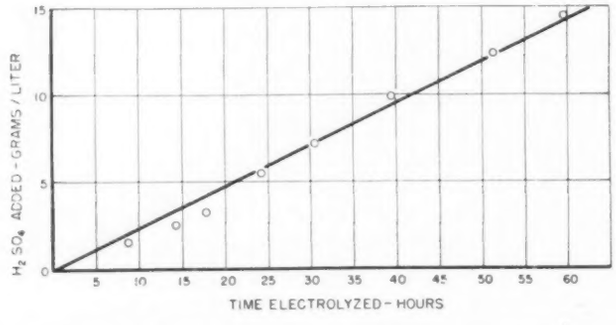

Fig. 1. Rate of adding sulfuric acid to maintain chromic-sulfuric acid bath with carbon cathodes for anodizing 24S-T aluminum alloy at 40 volts and 95° F.

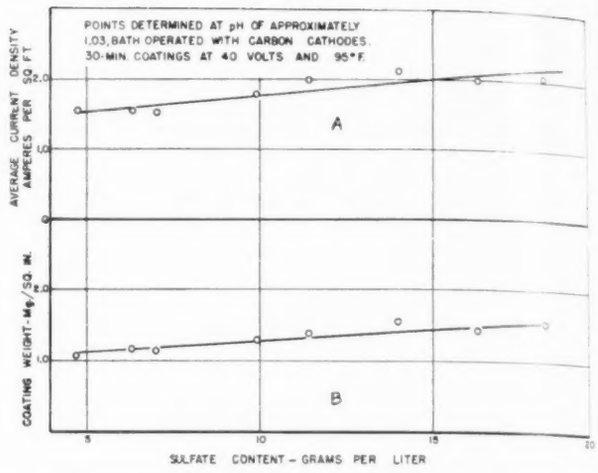

Fig. 2. Effect of sulfate concentration on current density and coating weight of 24S-T.

GROUP 2. Cathode current densities between 1.5 and 7.0 amperes per square foot. Results erratic, but severe surface pitting and large weight losses, increasing with sulfate content.

GROUP 3. Cathode current densities between 13 and 186 amperes per square foot. Surface of the cathodes not corroded but more or less covered with a dull chromium electrodeposit; different degrees of solution line corrosion observed, accounting for considerable weight loss especially at the higher sulfate contents.

These results show that freedom from serious attack can be expected only at very low cathode current densities and in baths containing relatively small quantities of sulfuric acid. Such limitations would defeat the purpose of the modified procedure.

A particularly severe pitting attack sometimes occurred on steel specimens immersed in the baths without current. This type of corrosion could not be duplicated at will or be related to any known variable. It usually occurred on cathodes that had been electrolyzed and then left in the baths overnight. It is possible that several factors, such as deposition of impurities on the steel surface, activation of the steel during electrolysis, concentration of sulfate in the bath, etc., might combine to produce the corrosive conditions.

Air agitation of the baths was shown to be an important variable affecting the corrosion of steel immersed without current in chromic acid solutions containing more than about 40 grams per liter of sulfate. It was also observed in these tests that steel specimens, which were allowed to stand in chromic acid before being tested, did not corrode so readily as those with a freshly cleaned and pickled, active surface. This factor was investigated further by testing the effect of air agitation on both activated and passivated steel specimens in baths containing up to 90 grams per liter of sulfate. In these tests no attack occurred on the specimens, either with or without air agitation at a sulfate content of 34-37 grams per liter. At 70 grams per liter, however, air agitation caused solution line attack on the active surfaces, but not on the passive surfaces; at 90 grams per liter, air agitation caused corrosion of the entire immersed active surfaces and solution line attack of the passive surfaces. No corrosion was observed in any of these tests in the absence of air agitation.

The results indicate that corrosion difficulties may be

expected when the modified process is carried out in unprotected steel tanks. Cathode current density, sulfate concentration, air agitation, and condition of the steel surface all influence the extent of corrosion.

Corrosion Prevention Methods

Supplementary cathodes of several metals and alloys were hung in front of the steel and tested for efficiency in protecting the steel against the corrosive attack. The distribution of current between the steel and the supplementary cathodes was measured and the surfaces were examined for corrosion. Considerable variation in current distribution resulted, depending on the metal being tested, but no significant decrease in corrosive attack on the steel was detected. In some instances corrosion was actually accelerated. More promising results were obtained through the use of carbon cathodes. A few tests indicated that carbon cathodes connected to the steel cathodes drew practically all of the current and prevented corrosion of the steel during electrolysis. However, the steel was still subject to the solution line attack caused by air agitation as described earlier. These results indicate that steel tanks should be protected with an acid-resisting paint, and inert cathodes should be used to carry the current.

Pickling inhibitors added to the baths failed to prevent corrosion of the steel, and experiments along this line did not appear promising.

Carbon Cathodes

Information on the behavior of carbon cathodes, without the interfering effect of iron corrosion products, was obtained by operating a bath contained in a glass jar, using cathodes made from National Carbon Company's furnace electrode stock, grade AGR. Specimens of 24S-T alloy were anodized at 40 volts and 95° ± 1° F. to age the bath, and 30-minute coatings were prepared periodically for coating weight determination. Starting with the stock solution at pH 1.05, electrolysis was continued until the pH had increased to between 1.15 and 1.20, and then sulfuric acid was added to reduce the pH to 1.00-1.05. This procedure was repeated throughout the two-week test period. The carbon electrodes were left immersed in the bath during idle periods. No appreciable change in appearance or evidence of disintegration of the carbon cathodes was visible at the end of the test. The operating relationships and results of the test are shown by graphs. Figure 1 gives the rate at which sulfuric acid was added to maintain the bath when used exclusively for anodizing 24S-T. It is expected that the rate might be different for other aluminum alloys. The

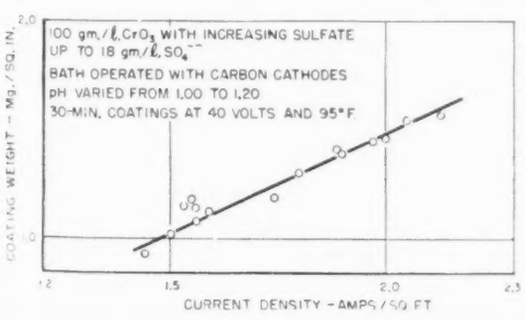
100 gm./L. CrO_3 WITH INCREASING SULFATE UP TO 18 gm./L. SO_4^{--}
BATH OPERATED WITH CARBON CATHODES
pH VARIED FROM 1.00 TO 1.20
30-MIN. COATINGS AT 40 VOLTS AND 95°F.
COATING WEIGHT - Mg./SQ. IN.
CURRENT DENSITY - AMPS./SQ. FT.

Fig 3. Effect of anode current density on weight of anodic coatings on 24S-T.

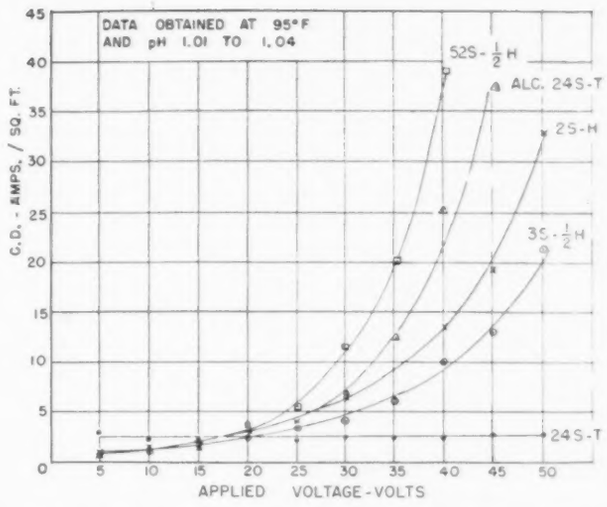

Fig. 4. Current-voltage relationship for aluminum alloys in 10% chromic acid plus 56.8 grams per liter of sulfate.

straight-line relationship indicates that a schedule for sulfuric acid additions based on the hours of electrolysis could be developed. Figure 2A shows the effect of increasing sulfate content on the current density at constant pH. Evidently, as the sulfate content increases, an increase in anode current density also results. The graph shows this to be a fairly consistent gradual increase, but it should be remembered that this relationship applies only in the low-sulfate range. Other experiments (Figure 5B) indicate that very little additional increase in current density on 24S-T takes place when the sulfate content is above about 30 grams per liter. Since the weight of coating formed is proportional to the current density, the graph of suulfate content against coating weight (Figure 2B) indicates the expected straight-line relationship. The points for Figure 3 were obtained while making the carbon cathode test run, during which both the pH and sulfate were varied. The straight-line relationship indicates that the coating weight is affected directly only by the current density. Since the thickness and those properties which are dependent upon coating thickness are proportional to the coating weight, it is apparent that current density control would result in more uniform coatings than pH control for the modified bath.

Anodizing Characteristics of Aluminum Alloys

Preliminary work indicated that certain aluminum alloys drew abnormally high current at 40 volts in chromic-sulfuric acid baths. This is an important point to consider when different alloys are being anodized simultaneously in the same tank. Therefore, further tests were made to establish the voltage-current relationships for several aluminum alloys in the various baths used in this investigation.

The voltage was applied to the alloy being tested and raised in 5-volt steps up to 50 volts. The current was recorded at each voltage after allowing a few minutes to reach equilibrium. In several cases at the higher sulfate content, the breakdown voltage of the film was exceeded; excessive current flow resulted, and the tests were stopped before 50 volts was reached.

Results of these tests verified the fact that the addition of sulfuric acid causes relatively large increases in current flow on most aluminum alloys. Figure 4 is a representative

graph showing the widespread variation in current density with increasing voltage on five aluminum alloys in a 10% chromic acid solution containing 56.8 grams per liter of sulfate. The difference between the alloys is striking, but it is also interesting to note the relatively small increase in current on alloy 24S-T. Earlier experiments had indicated that the current density on 24S-T at 40 volts increases from an original value of 1.0 to about 2.5 amperes per square foot, as the sulfate is increased to about 20-30 grams per liter. Additional increases in sulfate content caused only moderate increases in current density. This is the only alloy tested which shows such behavior. In view of these results it is obvious that assemblies of different alloys could not be uniformly anodized by the modified procedure at 40 volts. However, it is possible that better current distribution might be obtained at some lower voltage. For example, Figure 4 shows that at 15 to 20 volts current densities were nearly equal for all five alloys. The current densities at 15 and 40 volts for these alloys in the entire range of sulfate investigated were plotted as shown in Figure 5 to indicate the wide differences existing between these two extremes. One straight line sufficed to cover all the points for the five alloys at 15 volts. This is a desirable condition, making it possible to anodize assemblies composed of several different aluminum alloys at a relatively constant current density in baths containing various quantities of sulfate. In contrast, the curves at 40 volts show not only that the current flow to the different alloys varies widely, but also that increasing the sulfate content of the bath results in large increases in current density on all but alloy 24S-T. Obviously, those properties of the coatings that are influenced by their thickness are also subject to the same wide variations because the weight of the oxide film has been shown to be almost directly proportional to the current density.

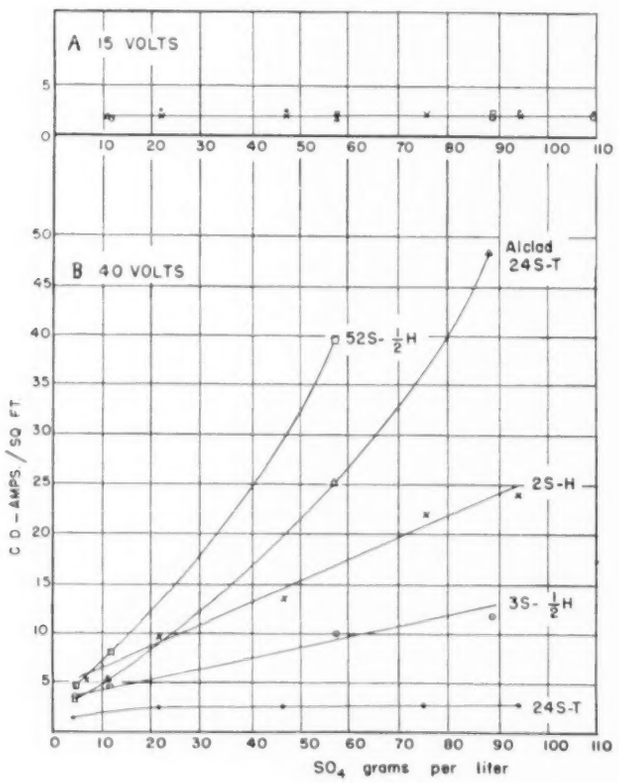

Fig. 5. Variation in current density on aluminum alloys at 15 and 40 volts in 10% chromic acid containing various amounts of sulfate at pH 1.01-1.04 and 95° F.

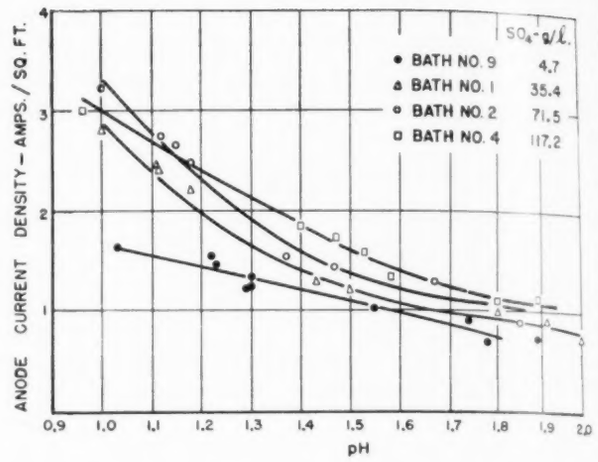

Fig. 6. pH vs. current density at 40 volts in 10% chromi acid baths containing various quantities of sulfate and anodes of 24S-T.

Bath Control

The question of bath control was mentioned briefly in the discussion of the carbon-cathode test results, and it was indicated that the process should be controlled by regulating the anode current density rather than the pH of the bath. Control of anodizing activity by adjustment of pH, however, has been widely used in commercial anodizing installations. Since current density at 40 volts varies so markedly with sulfate content at constant pH in the chromic-sulfuric acid baths, it is obvious that for general all-round work pH control would result in variations in coating thickness with varying sulfate content and alloy composition. It is possible, however, that pH control may be useful under certain conditions. For example, the points for the curve of current density against sulfate at 15 volts in Figure 5A were determined at constant pH of 1.01-1.04. The current density on all five alloys remains practically constant over the entire sulfate range. Therefore, at 15 volts, pH control should be feasible and should permit the maintenance of relatively constant current densities on the various alloys. The protective value of films formed in this way was not determined.

Another possibility for pH control of the modified bath at 40 volts, applicable only to alloy 24S-T, would be to determine the pH at which the desired current is drawn. Information on this point was obtained by operating four baths of different sulfate content, allowing the pH to rise normally through continued use from a starting value of 1.0 to a final value of about 2.0. Current densities at 40 volts were measured and plotted against the pH; Figure 6 shows that increasing the pH resulted in lower current densities in all four baths. The increase in current density with increasing sulfate at a normal operating pH of 1.0 is appreciable at lower sulfate concentrations, but tends to be considerably less in the upper range of 35 to 117 grams per liter of sulfate. Control of anodizing by pH maintenance in the upper range may be possible if the allowable tolerance in current density variation is within that shown by the upper three curves in Figure 6. The following tabulation taken from the curves

indicates how much variation in current density may be expected on 24S-T at several pH values:

pH	Av. Anode Current Density, Amp./Sq. Ft.	pH	Av. Anode Current Density, Amp./Sq. Ft.
1.0	3.0 ± 0.2	1.3	1.9 ± 0.25
1.1	2.6 ± 0.2	1.4	1.6 ± 0.2
1.2	2.2 ± 0.2	1.5	1.4 ± 0.2

If the variation in properties of the coatings obtained with these tolerances is acceptable, it should be possible to select the desired pH and maintain it by sulfuric acid additions as required. The foregoing information was obtained with steel cathodes and may have been influenced by the irregular effects due to the iron corrosion products. However, it is undoubtedly accurate enough to indicate the trend. With these exceptions it appears that more consistent results would be obtained by current-density control than by pH control.

Corrosion of Aluminum

The corrosion of aluminum in chromic-sulfuric acid mixtures was investigated briefly to determine the effect of acid retained in crevices and joints of assembled structures. Specimens of several alloys were immersed in portions of a used commercial chromic acid anodizing bath containing various quantities of aluminum sulfate. One set of specimens was immersed in a 15% sulfuric acid solution containing 54 grams per liter of additional sulfate for comparison. Weight loss determinations were made to indicate the severity of the corrosion.

The results of the tests (Table I) show that, in general, the corrosion was more severe in the baths of higher sulfate content. The specimens immersed in the sulfuric acid bath lost considerably more weight than those immersed in the chromic acid mixtures. These results were obtained under accelerated corrosive conditions, but they may serve as an indication of the amount of attack that might be caused by acid left in crevices under normal conditions.

TABLE I. CORROSIVE EFFECT OF ANODIZING ACID MIXTURES ON ALUMINUM ALLOYS

(Specimens immersed in corroding solutions for 72 hours at 120° F.)

	Weight Loss, Mg./Sq. In.			
Solution, Grams/Liter	24S-T	52S-½H	3S-½H	Alclad 24S-T
230 CrO_3 + 0.3 SO_4	4.2	1.2	0.9	2.8
230 CrO_3 + 20.0 SO_4	13.4	11.4	11.2	12.5
230 CrO_3 + 80.0 SO_4	15.8	13.2	12.5	11.9
65 H_2SO_4 + 54.0 SO_4	173.0	70.9	70.8	90.7

[a] A used, commercial anodizing solution was used as the base for these baths and the sulfate ion was added as aluminum sulfate.

Conclusions

1. Operation of the modified chromic acid anodizing bath using sulfuric acid for maintenance, introduces a severe corrosion hazard to the steel tanks that are commonly used for the straight chromic acid process. The corrosion of steel is affected by several factors—sulfate content, air agitation, and cathode current density. Protective coatings should be applied to all steel surfaces exposed to the action of the chromic-sulfuric acid electrolyte.

2. From the laboratory tests described, carbon appears to be a satisfactory cathode material for use in protected steel tanks.

3. The weight of coating produced is determined by the anode current density and time of treatment, and is independent of the sulfate content, at least in the lower sulfate range.

4. The sulfuric acid maintenance procedure causes radical changes in the current density-voltage relationships as the sulfate content increases at constant pH. Coating thickness, therefore, cannot usually be controlled by maintaining a constant pH, voltage, and treatment time.

5. The thickness of the oxide film is effectively controlled by maintaining operating conditions to give a constant anode current density. This can be accomplished by changing the pH of the solution as the sulfate content increases or by changing the voltage.

6. In the special case of the 24S-T alloy, anodized in chromic acid containing more than about 35 grams per liter of sulfate, operation at constant pH and voltage results in a current density that is essentially independent of sulfate content.

7. With the modified process, operated at 40 volts, segregation of the various aluminum alloys is necessary at any appreciable sulfate content. At 15-20 volts such segregation should not be necessary since the current density on all of the alloys investigated was essentially the same.

8. Within the limitations indicated from laboratory tests, the chromic-sulfuric acid process appears to offer an attractive saving in chromic acid.

Acknowledgment

Acknowledgment is made of permission by OPRD to publish this paper and to the Project Committee for suggestions and guidance.

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SHOP PROBLEMS

PLATING AND FINISHING
POLISHING—BUFFING
CLEANING — PICKLING
HOT DIP FINISHES

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Smooth Copper Plating

Question: What can I do to obtain a smooth copper deposit free from treeing? I am using the following solution:

28 oz. copper sulfate
1 oz. aluminum sulfate
3 oz. sulfuric acid
1 gal. water

at voltage of 1½ and a deposition time of from 6 to 8 hrs.

M. E. L.

Answer: To obtain smooth deposits keep the plating bath free of particles by filtration and bagging of the anodes. Glue or phenolsulfonic acid as addition agents may help. This solution should be operated at a temperature of 95° F. and could be improved by a somewhat higher acid content.

Rusty Looking Chromium

Question: We would like to get any information you might give us re chromium plating which gets a rusty looking film on it in a very short time when plated over brass. We are using both the standard watts formula nickel and a hot bright nickel. It does not seem to make much difference which nickel we use, the results are about the same, so we believe it is in the chromium. This film usually shows up from two to four weeks after plating and is the same on both bronze castings and brass tubing. We are of the opinion it is caused by trivalent chromium, but would like a little more information if possible. We have three tanks and the trivalent ranges from two to three in each tank—do you think this is high enough to cause the trouble?

H. F. C.

Answer: We do not believe that the present trivalent content of these solutions would cause this condition. It is probably due to tarnishing of the underlying brass due to an insufficient deposit of nickel underneath the chromium.

You can check this by immersing a tarnished piece in a solution containing 4 oz./gal. sodium cyanide to see whether the tarnish is removed.

Silver Brightener

Question: We understand that there is now on the market a commercial brightener for potassium cyanide silver solution. Can you give us details?

J. D.

Answer: Ammonium thiosulfate is the brightener employed and is sold as a 60% solution by the General Chemical Corporation, 40 Rector St., New York 6, N. Y. We would suggest that you write them for a copy of their bulletin on this subject.

Nickel Solution

Question: We would like to know if a room temperature nickel solution to be made up could later be converted to a warm solution and if a 99% depolarized anode would serve both solutions.

A. B.

Answer: If nickel chloride is substituted for the ammonium chloride generally used in a cold solution, it can readily be converted to a hot or bright nickel by the addition of the required salts. All ammonium salts should be kept out of the solution but, when working at room temperature the pH. of the new solution may be brought up to 5.8 with ammonia. This small amount of ammonia will not interfere with future operations at high temperature.

99% plus depolarized anodes are suitable for both cold and hot solutions.

Disposal of Zinc Bath

Question: I wish to secure some in formation relative to disposal of a fe hundred gallons of partially used zi plating solution. As is well known, t rather high sodium cyanide content such solutions poses quite a proble when one proposes to dispose of the in the ordinary manner of waste ma terials.

It is my thought that you may ha received other inquiries than my ow relative to this very same matter, a I trust that a satisfactory solution w found and offered to the party co cerned. If you are unable to offer suggestion to me, are you in a positi to direct me to another party where may obtain the information desired

R. D. H.

Answer: In order to kill the cyanid an extensive and rather expensive setu would be required and such solutio are, therefore, ordinarily run into t sewer. If possible, we would sugge that you dump the solution a little a time in order not to contaminate t sewage.

Plating and Cleaning

Question: Please send at my expen all information in regards to silv plating and cleaning white metal. the name of such books covering t subject.

H. S. A.

Answer: A section on silver plati appears in the latest edition of t Plating & Finishing Guidebook, copi of which are obtainable from this o fice at $1 per copy.

We know of no books covering t subject of cleaning white metal b would suggest that you communica with a local supplier of alkaline clea ers who will be in a position to fu nish you with a suitable material a information as to its use.

Nickel Plating Solder

Question: We have been made de inite but contradictory statements re recently on the following matter, a would appreciate your comment.

e a bright nickel plating bath, pH verage of 3. We have been told that ft solder on articles plated in the th will eventually affect the color and rightness of the nickel plate, and that en hard solders will have the same fect. In some cases we use this bright ickel as a preplate for other plating.

M. K. M.

Answer: Solder will affect bright ickel baths only if it dissolves to a sufficient extent to contaminate the solution. With suitable precautions against uch contamination no such trouble hould be experienced.

Aluminum Cleaning

Question: We are now manufacturg a line of Aluminum Gift Ware and ve been finishing our products with austic soda etching, i.e., a dip in 20% austic solution tank, rinse in clean ater, dip into nitric acid to eliminate nd neutralize residue of caustic soda, nd then rinse finally. We find this ethod to be satisfactory in giving the nish we now use.

We intend to finish some of our roducts in the spun finish by using mery cloth and kerosene in order to cratch the surfaces and procure this ffect. We would like to know if there any method that we can use as a nal cleaning agent that will wash way any heavy grease that may be in e inside of our units deposited there the course of Metal Spinning. The rease we use for this purpose is Hard lbany Grease. It is also of paramount portance *not* to create an etched surce and if it is at all possible we would e to use our present equipment.

S. H.

Answer: Cleaner manufacturers can rovide suitable materials which will move this grease without etching the uminum. The grease may also be moved in a solvent degreaser if it es not contain solvent-insoluble maerials.

Nickel Strip from Brass

Question: I would like a formula for ripping nickel from brass. Please adse if you have one.

F. A. W.

Answer: The following is suggested:

Sulfuric acid	5 pints
Water	3 "

Room temperature, reverse current at 6 volts.
Sheet lead cathodes.

Cast Iron Cleaning

Question: In electro-galvanizing of cast iron, I have been having considerable trouble with the objects becoming passive. The following steps were used.

1. Alkaline cleaner
2. Pickle
3. Cyanide dip
4. Plate

I also tried a mercury strike but found that in some cases it worked and in others it did not.

A. N. D.

Answer: Dip in molten caustic soda containing some sodium nitrate to dissolve the graphite. Then dip in sodium bisulfate to remove the oxide, following which the article can be plated.

Leather Finishing

Question: Our business consists of transforming leather into keepsakes and novelties, and at the present time we harden them and then spray with gold bronze powder.

If there is any additional information whereby we could change our process into actual metal spraying, we would appreciate receiving all the information you can give us, and also suppliers whom we could contact.

A. J. S.

Answer: Metal spraying has been employed for coating leather although electroplating is more commonly practiced. Equipment for metal spraying is obtainable from the following:

Metallizing Engineering Co., Inc.
Long Island City, New York
Metallizing Corp. of America
Chicago, Illinois
Schori Process Company
8-11 43 Road
Long Island City, N. Y.

ORDINARY CHROMIUM PLATING FAULTS

Metal Finishing presents the following chart of daily ills in chromium baths together with reasons and corrective measures:

Chromium

Fault	*Reason*	*Correction*
Areas of smokiness.	Grease or dirt on nickel coat.	Improve rinse cycle; do not handle work.
Bluish smokiness.	Solution too dense.	Check density and dilute with water.
Plating at edges only.	Dirty anodes, short circuits, or wrong chromic acid-sulfate radical ~~radio~~ ratio.	Clean anodes, correct short circuits and check chromic acid-sulfate radical ratio.
Poor throwing power and burning.	High sulfate content.	Add barium hydroxide or discard part of solution and add water and chromic acid.
Dark stains.	Chromium solution drying on work prior to plating.	Keep work clean before plating.
No plating.	Impure bath, generally contaminated with hydrochloric or nitric acid.	Dilute great part of solution with water and adjust chromic acid-sulfate ratio.
Irridescence on drying out.	Rinses and drying facilities after plating unclean.	Correct all rinses and dryers.
Peeling to base metal.	Improper cleaning before nickel plating.	Correct original cleaning cycles.
Peeling to nickel coat.	Double coats of nickel due to interrupted current flow.	Check nickel circuit for loose connections on work. Check racks, anode and cathode connections and short circuits in tank.

THIS IS WASHINGTON—

By George W. Grupp
METAL FINISHING's Washington Correspondent

The Wage Structure of Commercial Job Electroplating Shops

The electroplating industry is expected to play an increasingly important role in the production of durable consumer goods in the postwar period. For this reason the Wage Analysis Division of the Bureau of Labor Statistics of the United States Department of Labor made the first nation-wide comprehensive wage structure study of commercial job electroplating shops. The completed study covers the wartime wage scale of January 1945. In the future a study will be made of the peacetime wage structure of commercial job electroplating shops.

In this study of commercial job plating shops there was not included the electroplating sections of machinery, machinery accessory, machine tool and automotive vehicle manufacturers because the wage structure of platers and polishers of these industries are included in separate studies.

The completed study reveals that most of the commercial job plating shops are concentrated in or near cities of 100,000 or more in population. The greatest number of the shops are located in the Great Lakes and Middle Atlantic regions with the New England and Pacific regions next in rank.

In the accompanying tables, which were compiled from the study made by the Bureau of Labor Statistics, the term "average straight-time hourly earnings" does not include premium overtime pay, shift differentials, or any additional money income such as non-production bonuses, vacation and sick pay, and paid insurance premiums But it does include direct incentive earnings.

Under normal conditions there is a tendency for the smaller shops to employ a higher number of polishers and buffers in proportion to the number of platers. However, in this connection it should be noted that during the war the corrosion-proofing coatings for military purposes required less polishing than peacetime civilian goods. This condition reduced the number of polishers in proportion to platers on war-work.

During the war the commercial job platers' work consisted largely of the plating of parts of airplanes, radios and other military equipment. It also compelled changes in the type and amount of plating metals used. Scarcity of metals sometimes curtailed plating operations, and available inferior substitutes had to be used. But now these commercial job plating shops are again serving the manufacturers of automotive accessories, lighting fixtures, electrical appliances, and other civilian consumer durable goods requiring a smooth surface and high polish.

The study revealed that in commercial job electroplating shops, like all other job and contract shops, the ratio of labor costs to total production costs is rather high.

The highest wages, according to the study, are paid in the Pacific Coast region, with the Great Lakes region ranking second. Wages are higher in the larger cities. And the wage scale of the large cities have a material influence on the wage scale of the nearby towns.

Many plating shops raise the pay of their workers after a formal probationary period, or after the required dexterity or skill of the worker has been attained, which is normally from 30 to 90 days after hiring.

In this study it is interesting to note that the wage scale of male platers ranges from 89 cents an hour in the Newark-Jersey City area to $1.14 an hour in Los Angeles. Male platers' helpers wages range from 68 cents an hour in New York City to 96 cents an hour in Detroit. On the other hand the female platers' helpers wages range from 58 cents an hour in Cincinnati to 89 cents an hour in Detroit.

The source for the following tables is the Bureau of Labor Statistics, Labor Department.

TABLE NO. I

Commercial Job Electroplating and Polishing Establishments in the United States, January 1945

Region	*Total Number in United States*		*Number Studied*	
	No. of Establishments	*No. of Workers*	*No. of Establishments*	*No. of Workers*
New England	46	1,460	37	1,308
Middle Atlantic	126	4,230	65	2,664
Border States	7	212	7	212
Great Lakes	166	6,580	107	4,419
Middle West	4	125	4	125
Southwest	5	75	4	57
Pacific	44	1,215	26	829
Total United States	400	14,000	252	9,717

TABLE NO. II

Total Number of Workers and Average Straight-Time Hourly Earnings of All Employees of Commercial Job Electroplating and Polishing Establishments in the United States, January, 1945

Region	*Number of Workers*		*Average Hourly Wages*	
	Men	*Women*	*Men*	*Women*
New England	986	361	$0.91	$0.62
Middle Atlantic	3,243	981	0.86	0.65
Border States	155	33	0.82	0.72
Great Lakes	4,652	1,553	0.99	0.73
Middle West	103	18	0.86	0.68
Southwest	68	...	0.87	...
Pacific	961	349	1.11	0.77
United States	10,267	3,295	$0.94	$0.70

TABLE NO. III

Percentage of All Employees in Commercial Job Electroplating and Polishing Establishments in the United States, January, 1945

Occupation	*Employees*	*Men*	*Women*
Maintenance men, gen'l. utility	1.9%	1.9%	...
Other maintenance workers	1.3	1.2	0.1%
Working foremen, processing department	4.2	4.1	0.1
Platers	16.6	15.9	0.7
Platers' helpers	*31.9	21.1	10.8
Polishers & buffers, metal	6.5	6.4	0.1
Polishing & Buffing machine operators	3.9	3.7	0.2
Other process workers	3.9	3.5	0.4
Inspectors	0.8	0.3	0.5
Apprentices	1.3	1.3	...
Learners & helpers	0.3	0.3	...
Factory clerical workers	0.9	0.5	0.4
Loaders and unloaders	1.6	1.5	0.1
Truck drivers	1.3	1.3	...
Custodial employees	2.2	2.1	0.1
Other shop workers	16.2	6.8	9.4
Office workers	5.2	0.6	4.6
Total	100.0%	72.5%	27.5%

TABLE NO. IV

Average Straight-Time Hourly Earnings of Selected Occupations in 252 Commercial Electroplating and Polishing Establishments in the United States, January, 1945

Occupation	*Men*	*Women*
Janitors	$0.73	...
Loaders and unloaders	0.79	...
Maintenance men, gen'l. utility	1.02	...
Platers	1.00	$0.85
Platers' helpers	0.78	0.68
Polishers & buffers, metal	1.18	...
Polishing & buffing machine operators	1.18	...
Truck drivers	0.92	...
Watchmen	0.65	...
Working foremen, processing dept.	1.20	...

TABLE NO. V

Average Union and Non-Union Straight Time Hourly Earnings of Selected Occupations in 252 Commercial Electroplating and Polishing Establishments in the United States, January, 1945

Occupation	*Union Shops*	*Non-union Shops*
Janitors	$0.74	$0.72
Loaders and unloders	0.78	0.80
Maintenance men, gen'l. utility	1.03	1.01
Platers	1.00	1.00
Platers' helpers	0.73	0.80
Polishers and buffers, metal	1.16	1.19
Polishing and buffing machine operators	1.11	1.22
Truck drivers	0.90	0.92
Watchmen	0.66	0.64
Working foremen, processing department	1.25	1.19
Women Platers	0.84	0.86
Women Platers' helpers	0.68	0 69

TABLE NO. VI

Characteristics of Commercial Electroplating and Polishing Establishments in the United States, January, 1945

Item	*Number of Shops*
Total number of shops studied	252
Number of union shops	66
Number of non-union shops	186
Number of shops employing 8 to 50 workers	201
Number of shops employing over 50 workers	51
Number of shops located in communities of less than 100,000 population	42
Number of shops located in communities of over 100,000 population	210

TABLE NO. VII

An Analysis of Bonus, Vacation and Pension Plans for Plant Workers of 252 Commercial Electroplating and Polishing Establishments in the United States, January, 1945

Item	*Number of Shops*
Attendance bonuses	3
Christmas bonuses	125
Profit sharing bonuses	5
Other non-production bonuses	8
Total with non-production bonus plans	141
Number without non-production bonus plans	111
Number which give workers paid vacations	130
Number who do not give workers paid vacations	122
Number with life insurance, health insurance, retirement pension, etc. plans	66
Number without life insurance, health insurance retirement pension, etc. plans	186

Long Term Control of Antimony and Tin Should Be Established Says Small John Small, Civilian Production Administrator, is of the opinion that long range Government control over antimony, tin and uranium must be established. Who will carry out this program when the CPA expires on March 31, 1947, he did not say. He said that the Government stockpile of tin would be wiped out in 30 to 60 days if the Government did not maintain control over this commodity.

Production of Chemicals in August The Department of Commerce reports that during August 1946, the production of synthetic anhydrous ammonia amounted to 75,794 short tons; ammonium nitrate 77,638 short tons; ammonium sulfate 10,683,000 pounds; calcium carbide 53,399 short tons; chlorine 102,505 short tons; hydrochloric acid 29,519 short tons; 196,000 gallons of methanol; 59,144 short tons nitric acid; phosphoric acid about 140,000 short tons; soda ash over 600,000 short tons; sodium hydroxide about 200,000 short tons; sodium sulfate about 67,000 short tons; and sulfuric acid about 2,000,000 short tons.

Gold Plating Reduces Losses of High Frequency Current According to a 34 page report, (PB-16380) issued by the Office of Technical Services, gold plating of the metal leads sealed in the glass envelopes of vacuum tubes greatly reduces losses of high frequency current. A photostatic copy of this report may be had for $4.00.

September Copper Production Highest Since October 1945 The Copper Institute announced that during September 1946 the production of crude copper reached a total of 69,689 tons and refined copper production totaled 67,803 tons. The production of crude copper was the highest since October, 1945.

Modifications in Premium Price Plan For Copper, Lead and Zinc Director of Economic Stabilization, John R. Steelman, recently issued amendment No. 1 to Directive 137 to amend Section 4003.67a, Part a (4), to read as follows: "Provision for adequate allowance for depletion. To margins calculated as heretofore under the Premium Price Plan for Copper, Lead and Zinc shall be added 25% of the net market value for each metal, other than copper, lead and zinc contained in those ores for which payment is made to the producer who owns the property from which the ores are produced."

16,300 Tons of Silver to Be Returned to the Treasury The Office of Defense Plants of the Reconstruction Finance Corporation is planning to return to the Treasury Department 16,300 tons of silver which it borrowed in 1942 for use in RFC war plants. At present this silver is in the form of slabs cut from bus bar sections and from large electrical transformers. All of the silver is expected to be recast into ingots or commercial bars by the United States Mint.

The Price of Silver Drops for one Day During the past month the price of silver dropped to 89 cents an ounce, but the next day it again rose to 90⅛ cents an ounce. A number of reasons were given for this temporary drop in the price of silver, among them was the report that 85 tons of silver are enroute to the United States from Spain.

Lead Order M-38 Amended The Civilian Production Administration amended General Preference Lead Order M-38 on October 3, 1946, to define the meaning of term "military order" (b) to amend Section C, Part 3, to read in part: "Manufacturers or processors who did not use lead, or were not authorized to use it, during the period indicated as the base period in the manufacture of an item or in a process which is subject to a quota restriction (including persons who were not in business at that time) may nevertheless apply for a quota."

Lead Order L-354 Has Been Amended Limitation Order L-354 was amended on October 8, 1946 by the Civil Production Administration. The amended order provides that no one shall process in any calendar quarter a quantity of lead in excess of 35% of the lead processed during the first six months of 1944, or 5,000 pounds, whichever is the greater. It also provides that the production of lead chrome pigments shall not be in excess of 70% of quantity processed during the first three months in 1946 or 1,000 pounds, whichever is greater.

Predicts Tin Production of 12,000 Tons in Indies F. C. Houwert, managing director of the Billiton Tin Company recently predicted that in the near future the Netherlands Indies will be producing tin at the rate of 12,000 metric tons a year.

Platinum Prices Drop The decrease in the demand by the jewelry trade for platinum recently caused the price to drop from $90-93 an ounce to $85-88 an ounce. But this price may advance again before Christmas as the supply of platinum has not increased.

Primary Zinc Prices Increased One Cent per Pound The Office of Price Administration issued on October 14, 1946 Amendment 6 to RPS 81, to increase the ceiling price of primary slab zinc by one cent per pound. In this amendment the base price for different grades of zinc were fixed as follows: Prime Western 9.25 cents a pound; Selected 9.35 cents; Brass Special 9.50 cents; Intermediate 9.75 cents; High Grade 10.25 cents; and Special High Grade 10.25 cents.

New Ceilings for Zinc Scrap Fixed by OPA In Amendment 3 to MPR 3 issued by the Office of Price Administration, maximum prices were established for zinc scrap materials, new zinc clippings and trimmings 8.00 cents per pound, f.o.b. point of shipment; engravers' and lithographers' plates 8.00 cents; old zinc scrap 6.50 cents; unsweated zinc dross 6.55 cents; die cast slab 6.55 cents; forming and stamping dies 5.70 cents; new die cast scrap 5.70 cents; radiator grilles, old and new 5.70 cents; and old die cast scrap 5.25 cents.

Soda Ash Production to Be Increased Officials of the Civilian Production Administration predict that there will be an increased production of 450 metric tons of soda ash in the near future because of the expansion of production facilities of a number of plants.

Efforts Made to Free Zinc and Lead from Price Control Since the Office of Price Administration is not planning an immediate decontrol of such basic metals as lead and zinc, the price controls and premium price subsidies have been vigorously attacked by certain interests. And it is clear that a concerted effort will be made to liberate these metals from price control.

Anaconda to Build Phosphoric Acid Plant The Anaconda Copper Mining Company is having plans prepared for the construction of a $1,000,000 phosphoric acid plant at Anaconda, Montana.

Zinc Production During Past Four Months The American Zinc Institute reports that production of slab zinc amounted to 58,657 tons in September, 1946, as compared with 59,752 tons in August, 1946, with 59,014 tons in July, 1946, and with 58,812 tons in June, 1946.

RFC Buying Foreign Copper and Lead to Build Up Domestic Stockpile. During the fourth quarter of 1946 the Office of Metals Reserve will buy 40,000 tons of copper from Chile and 24,000 tons of lead from Mexico.

Steelman Authorizes RFC to Subsidize Metals On September 27, 1946 Stabilization Director John R. Steelman authorized the Reconstruction Finance Corporation to continue absorbing fluctuating losses under its domestic metals and minerals subsidy.

Antimony Imports Again Under Import Control The Civilian Production Administration reestablished import controls on antimony ore and metal on October 14, 1946. This action was taken to curb the growing practice of importing antimony ore and metal for refining and then exporting it to other countries.

Patents

Electroplating Bath

U. S. Pat. 2,406,072. K. M. Gaver, assignor by mesne assignments to the Ohio State University Research Foundation, Aug. 15, 1946. A plating bath for the electrodeposition of metal comprising an aqueous solution providing ions of the metal to be deposited and a metal starchate addition agent comprising the reaction product of starch and an alkali metal.

Aluminum Coating

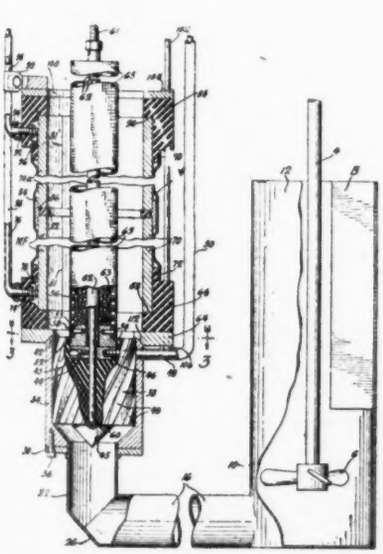
U. S. Pat. 2,406,245. K. Oganowski, N. W. Parks, and K. G. Coburn, assignors to the American Rolling Mill Co., Aug. 20, 1946. A hot dipped ferrous article coated with an aluminum alloy, the said coating comprising a thin layer located next the ferrous article and comprising an iron-silicon-aluminum-magnesium alloy, and a substantially thicker external layer of high aluminum content and containing also silcon from substantially 7.5 to substantially 9.5%, and magnesium from substantially 2.0 to 2.5%, the said ferrous article being characterized by ductility and high adherence of said coating.

Tin Plating Process

U. S. Pat. 2,406,189. N. F. Blackburn, assignor to E. I. DuPont de Nemours & Co., Aug. 20, 1946. A process for electroplating tin which comprises electrolyzing an aqueous solution of an alkali metal stannate and an alkali metal hydroxide with an alloy anode comprising essentially tin and at least one alkali metal, the total alkali metal content of said anode being 0.1 to 10% by weight.

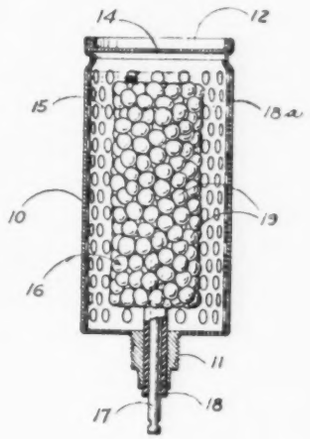
Electroplating Bearing Shells

U. S. Pat. 2,406,956. C. F. Matthews, assignor to General Motors Corp., Sept. 3, 1946. In a cathode apparatus for electroplating the bearing shells of bearings of crankshafts used on internal combustion engines, a first mask, a second mask, a plurality of superimposed aligned pairs of bearing half shells positioned between the masks and spacing them from each other, a cover of nonconducting material over the outside of the shells, means removably to hold the masks and shells in assembled relation and current conducting leads mounted in the masks and connected with the end pairs of bearing shells.



Electrolytic Electrode

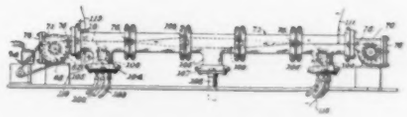
U. S. Pat. 2,406,345. J. B. Brennan, Aug. 27, 1946. An electrode for electrolytic devices comprising a mass composed of a plurality of pellets of insulating material of substantially uniform size, the surfaces of said pellets being coated with conductive metallic layers composed of minute particles, the pellets being many times larger than said particles, and a terminal member in circuit



with the layers on substantially all of said pellets. The method of making electrodes for electrolytic devices which includes the steps of providing a plurality of pellets of base material of substantially uniform size, spraying the surfaces of said pellets with finely divided particles of molten metal to provide a conductive layer thereon, and assembling a plurality of said pellets with the layers on substantially all of said pellets in circuit with each other.

Coating

U. S. Pat. 2,405,662. C. E. McManus, J. D. Elder, G. B Cooke, and A. J. Dornblatt, assignors to Crown Cork & Seal Co., Inc., Aug. 13, 1946. A method of coating a metal sheet with a vaporized metal comprising introducing the metal to be coated, prior to coating into a feeding zone and maintaining the same under reduced pressure therein, continuously advancing the metal sheet from said feeding zone in a substantially horizontal plane, while maintaining the metal sheet under reduced pressure, into a coating zone with the metal sheet at a temperature below that of the vaporized metal, maintaining that coating zone also under reduced pressure twisting the metal sheet through an angle



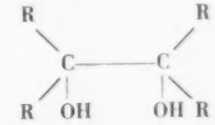
of substantially 180° in the coating zone as it travels through the same, vaporizing the coating metal in said coating zone continuously as the metal sheet travels therethrough, maintaining a difference in potential between the continuously traveling metal sheet and the vaporized metal ions to thereby direct the vaporized metal to the metal sheet and to deposit the vaporized metal upon successively exposed longitudinally spaced opposite surfaces of the continuously traveling metal sheet presented by said twisting while the metal sheet is moving through the coating zone, and continuously collecting the coated metal sheet from said coating zone in a zone maintained under reduced pressure.

Pickling Bath

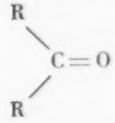
U. S. Pat. 2,406,379. A. D. Johnson, assignor to E. I. DuPont de Nemours & Co., Aug. 27, 1946. A free-flowing, pulverulent composition adapted to be dispersed in an aqueous acid solution to form a metal-pickling bath, the composition comprising about from fifteen to thirty-five per cent by weight of a liquid thiazolinyl sulfide dispersed on a finely divided solid soluble in a dilute aqueous acid bath in the concentration in which it would be added with the amount of thiazolinyl sulfide required to give the desired inhibition and having an average particle size of less than about five microns and a maximum particle size of less than about 200 microns.

Electrolytic Pinacol Production

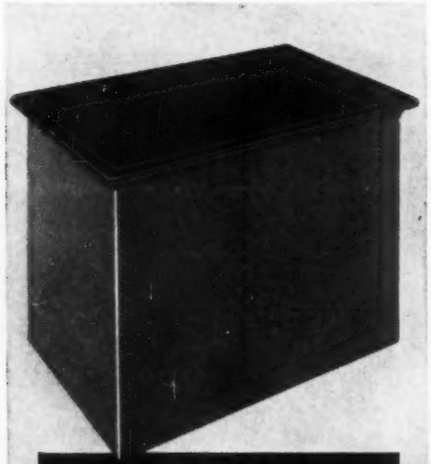
U. S. Pat. 2,408,101. O. C. Slotterbeck, assignor to Standard Oil Development Co., Sept. 24, 1946. In the process of producing glycols corresponding to the general formula



wherein R stands for a member of the group consisting of alkyl and aryl radicals and substituted alkyl and aryl radicals by the electrolytic reduction of an aqueous acid solution of a ketone of the formula



wherein R stands for a member of the group consisting of alkyl and aryl radicals and alkyl and aryl radicals substituted by a group which is not reducible under the reaction conditions, the improvement which comprises effecting the said reduction at a cathode consisting of copper coated with zirconium.



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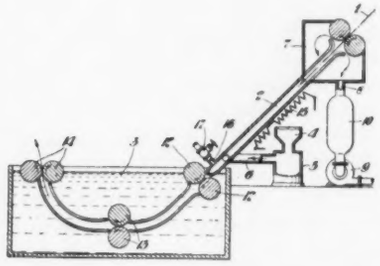
Process of Galvanizing

U. S. Pat. 2,405,592. A. J. Mauger and A. H. Ward, Aug. 13, 1946. The process of



galvanizing ferrous metal shapes, such as sheets, strips, and wire, which comprises passing the shapes through an atmosphere of ammonium chloride vapors maintained within a temperature range of from 420° F. to 824° F., admitting excess air into the ammonium chloride vapor atmosphere, immediately passing the shape from the said atmosphere through a galvanizing bath, and controlling the said temperature and admission of air for obviating formation of substantial amounts of ferrous chloride on the shapes by reactions of the ammonium chloride vapors with the ferrous metal of the said shapes.

Treating Machine

U. S. Pat. 2,408,248. Q. C. Barber; J. E. Burnside, administrator of Q. C. Barber, deceased. Sept. 24, 1946. In a device of the character described, the combination of a treating vat, a work support adapted to move into and out of said vat, means of urging said work support to a position out of said vat, a cross-head continuously operating means for reciprocating said cross-head, and means for releasably connecting said work support to said cross-head.

Selenium Coating Method

U. S. Pat. 2,408,116. A. von Hippel, assignor to Federal Telephone & Radio Corp., Sept. 24, 1946. In the coating of metal surfaces for the production of selenium coated plates the steps which comprise treating the metal surface with a solution containing a form of selenium to form a metal-selenium compound thereon and thereafter coating the treated surface with selenium.

Abrasive Articles

U. S. Pat. 2,408,319. S. S. Kistler, assignor to Norton Co., Sept. 24, 1946. An abrasive article comprising abrasive grains, a bond uniting the grains as an integral body, and the combination of iron sulphide and potassium fluoborate interspersed throughout the bonded mass.

Copper Electrolysis

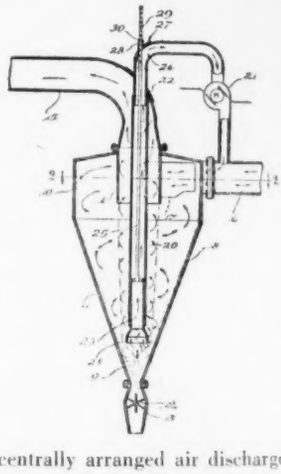
U. S. Pat. 2,408,668. W. C. Mason, assignor to Inspiration Consolidated Copper Co., Oct. 1, 1946. In a process for the production of electrolytic copper cathodes involving electrolytic precipitation of copper from a sulphuric-acid-containing electrolyte, the improvement which comprises inhibiting the formation of sprouts on the cathodes during electrolysis by adding to the electrolyte an oil-treated acid obtained by agitating one volume of naphthenic crude oil with about five volumes of about 78% to 95% sulphuric acid, causing the oil-treated acid to settle and a tar-like material to form on top, and removing the tar-like material, the resulting oil-treated acid being added to the electrolyte in an amount corresponding to that produced by the treatment of about 1.4 to 2.0 gallons of the crude oil per ton of copper cathodes precipitated.

Tin Depositing Process

U. S. Pat. 2,408,515. S. G. Hopkins, Oct. 1, 1946. The method depositing tin on an iron surface which consists in coating the iron with powdered tin held in a co-polymer of vinyl chloride and vinyl acetate vehicle and in then heating the same to effect the fusion of the tin particles and their adhesion to the iron surface producing a fused continuous deposit of tin on the iron surface, the vinyl resin serving as a vehicle in the coating application and as a flux in the tin fusing step.

Cyclone Dust Collector

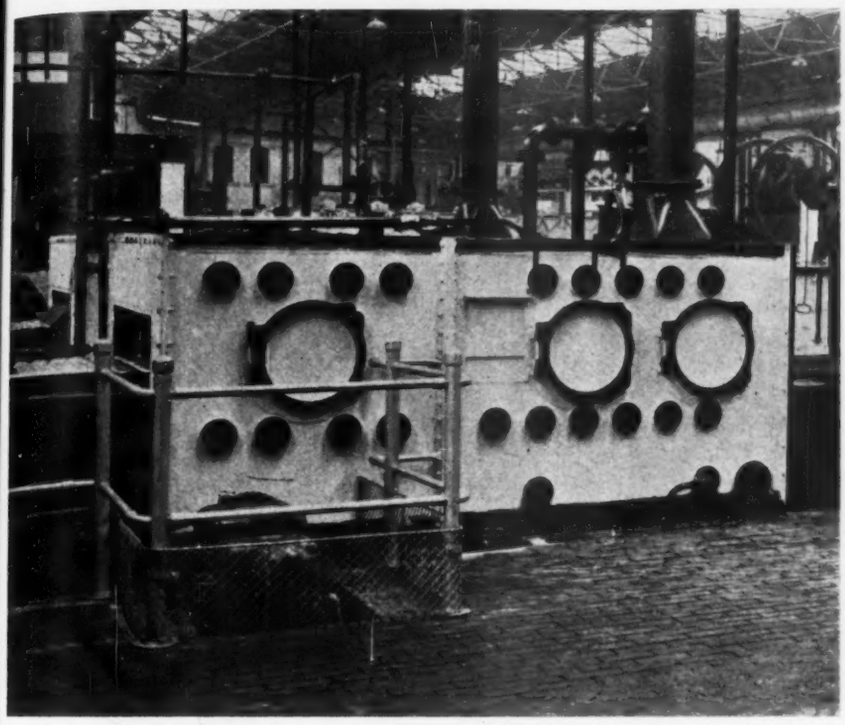
U. S. Pat. 2,408,250. J. Crites, assignor to Combustion Engineering Co., Inc., Sept. 24, 1946. A cyclone separator comprising, in combination, a conical separator casing hav-



ing a centrally arranged air discharge in its upper end, means including an inlet conduit for introducing dust laden air into the upper portion of the casing tangentially to the inner surface thereof to form a downwardly moving dust precipitating outer spiral of air and an upwardly moving inner concentric spiral of air being discharged, and means comprising a vertically disposed interceptor conduit arranged concentric to the separator casing and extending upwardly through the casing and said discharge to the exterior of the casing and provided at its lower end with an inverted hood of greater cross-sectional area than said conduit and positioned with its open lower end portion in close relation to the restricted lower end of the separator and said conduit communicating at its other end with the inlet end of the separator, a fan interposed in said interceptor conduit whereby dust suspended in said inner spiral of air at the lower portion of the separator is intercepted by said hood and directed through said interceptor conduit to the inlet conduit of the separator.

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY



Automatic Pickling Machine

A new spray-type machine for continuous pickling and washing of any metal part requiring surface preparation for the application of enamel or metallic coatings or for the removal of scale is announced by H. C. Klein, manager, rubberlined and rubber covered equipment, Industrial Products Sales division of The B. F. Goodrich Co.

Each unit is designed individually to suit the particular manufacturing problem and is lined with rubber by the company's Vulcalock process of adhering rubber to metal. The machine is said to have been used successfully for pickling cartridge cases and preparing steel hollow-ware for enameling. Among advantages cited by the company for the machine over the dip method are: straight line operation, with materials requiring minimum handling being fed into the conveyor feeding into the machine and carried automatically through each pickling and washing operation without intermediate handling; standardized production, with no special equipment being required for handling pieces of different shapes and sizes, the conveyor carrying any size or shape within the over-all size limits of the unit.

Flexibility of operation is possible, as the unit can be designed to fit almost any requirements, with different sizes and varying numbers of compartments for washing and pickling solutions.

Greater safety in operation is claimed through confinement of all acid and acid fumes in the chamber, eliminating danger from splashing and dripping, as well as fumes and the common hazards of dip pickling.

Acid use is claimed to be more efficient since it is circulated continuously, automatically providing complete agitation and efficient use for a longer time. In the old-type dip process the acid is not thoroughly agitated and thus is said to lose part of its effectiveness.

The machine should be of interest to anyone doing mass production of parts requiring thorough cleaning before enameling, plating, etc. For further information write to Dept. MF., Industrial Products Sales Division, The B. F. Goodrich Co., Akron, Ohio.

Brass Cleaner

Enthone, Inc., Dept. MF, 442 Elm St., New Haven, Conn. have developed a new alkali cleaner called Enthone Brass Cleaner.

This cleaner is stated to have high detergent ability and in addition, to have no tarnishing action on active metals including copper, brass, bronze, nickel silver, tin and lead, and can be used as a general plating room cleaner for cleaning of steel and the metals listed. It is said to have high detergent qualities for soak or electrolytic cleaning and can also be used for scrub cleaning, not containing strong alkalis.

A feature of the cleaner is the long life claimed for it during operation due to its stable surface active materials and buffered alkali balance.

A bulletin is available describing the features of this product.

Plating Rectifiers

Selenium Rectifiers ranging from 25 to 5,000 ampere output are a new line of equipments available from the Pariser Electric Motor Co., Inc.

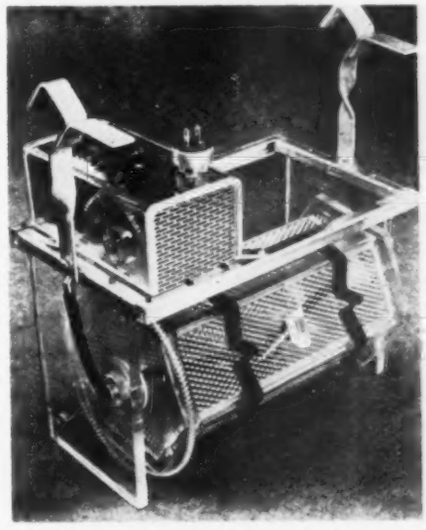
Standard accessories included with the rectifiers consist of voltmeter, ammeter, variable voltage regulator, on-and-off switch, safety fuse protection and pilot light. The units are guaranteed and it is claimed will give a lifetime of uninterrupted service. Dial mountings are designed to give uniform adjustment from zero to maximum voltage and amperage.

For further information write the Pariser Electric Motor Co., Inc., Dept. MF, 165 Centre St., New York 13, N. Y.

Transparent Plating Barrel

A new plating barrel made of Lucite is being manufactured by the Hardwood Line Co., Dept. MF, 540 N. Artesian Ave., Chicago 12, Ill.

Illustrated is the portable unit; the overall height is 17 inches, while the base dimensions are 12 by 17 inches; its net weight is 20



pounds. The motor is 110 volt, AC, 60-cycle, single phase, and has a male plug mounted on the top.

The firm also manufactures standard size plating barrels of Lucite. All barrels are made without ribs, decreasing loading and unloading time, it is claimed. Longer life and low maintenance costs because of con-

struction and material, are other claims made for the units.

Further information may be had by writing the company.

Midget Polishing Spinner

Far greater speed and much more uniform results in polishing and buffing small round, cylindrical and flat circular parts is claimed by using the Midget Work Holding Spinner, No. 221M, it is announced by The

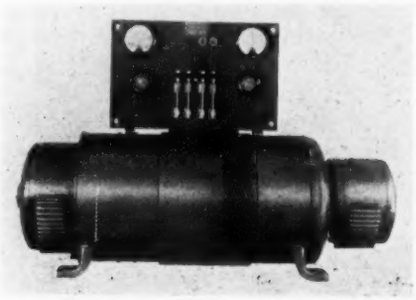
Manderscheid Co., Dept. MF, 810 Fulton St., Chicago 7, Ill.

Seven inches long and weighing 6 ounces, it is said the spinner facilitates quick and uniform polishing of small parts, such as jewelry, fountain pens, etc., with reduced fatigue to the operator. The one-piece shaft and brake assembly operates in grease-packed and sealed ball bearings which are mounted in precision-machined seats and are protected from dust and grit by housing closures. The shaft extension is ¼" in diameter, 1" long and machined flat on one side for holding the fixture with a set screw.

Electroplating Generators

A complete new line of low voltage electroplating generators is being announced by Motor Generator Corp., Dept. MF, Troy, O. The line includes 6 models ranging in size from 100 amperes at 6 volts to 2,000 amperes at 6 volts or 1,000 amperes at 12 volts.

Illustrated is the No. 130 model which is rated 1,000 amperes at 6 volts or 500 amperes at 12 volts. The generator is driven by a 10 horsepower motor at 1,200 r.p.m.



This model is designed for the job shop and manufacturer where still plating tanks are used for nickel, copper, brass or cadmium. The standard tank size normally used with this model is 6′ x 30″ x 30″, or a tank containing 250 gallons of solution. For chromium plating, individual 1,000 ampere, 6 volt generators are used right at the tank.

With this double commutator machine, the commutators can be connected in series to get 12 volts or less for barrel plating, electrocleaning, etc. Because of the large size, the machine is compound wound and equipped with interpoles or commutating poles which are said to give sparkless commutation, taking the place of diverter poles which are used in the smaller sets. Special metallic brushes are used to carry the high current while commutators are made with the riveted risers to cause a marked draft. The machine is well ventilated throughout and runs remarkably cool, according to the manufacturer. Another special feature is separate excitation of the generator fields, which is said to insure better plating characteristics.

Descriptive Data Sheet MGC 30 will be mailed on request to the manufacturer.

Portable Plating Barrel

The Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J. announces a recent plating barrel development, the Mercil Portable Barrel Unit, designed for small quantities of work.

The unit can be furnished with a steel

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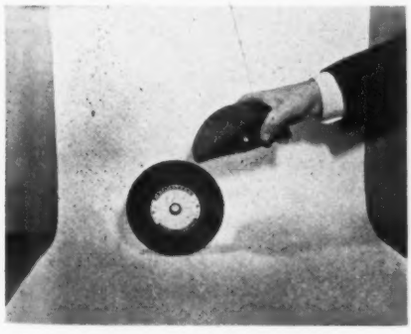
cylinder for cleaning, with a Monel cylinder for pickling, or with a rubber or Bakelite cylinder for plating. The cylinder for cleaning or pickling is 8″ in diameter x 18″ long. The apparatus is furnished with a special Janette motor-reducer to drive the cylinder at 1.6 RPM. The motor is totally enclosed and mounted on the tie rod assembly directly above the cylinder. The unit with the steel cylinder can also be used for tanks containing solution for black oxide finishes. The unit for plating has chain dangler contacts and the cylinder can be 6″ in diameter x 12″ long or 8″ in diameter x 18″ long. The Janette motor and reducer are arranged so that a cylinder speed of 5 to 6 RPM can be secured.

A cable is attached to the live end of the hanger so that the user can attach it to negative bus bar on the still tank.

The overall length of the portable unit with the 6″ x 12″ cylinder is approximately 20″, height, approximately 16″; weight, in the neighborhood of 70 lbs. A cylinder of this size will hold approximately 2 quarts of work.

Flexible Polishing Wheel

The Manhattan Rubber Division of Raybestos-Manhattan, Inc., Dept. MF, Passaic, N. J., announces its latest addition to its line of polishing and finishing wheels. This innovation is the most flexible of this series of soft neoprene bonded polishing wheels, according to the manufacturer. The extreme flexibility and "cushion" action of this wheel is said to be due to the fact that the wheel is bonded with a specially modified compound of neoprene impregnated with abrasive grain. The wheels are manufactured under Pat. Nos. 2,122,691-2,255,891 and are the result of over a decade of the manufacture of soft bonded finishing wheels. Working with a closely controlled method of



manufacture this neoprene wheel can be varied over a wide range of densities depending on its ultimate application. A combination of porosity and a soft bond results in a wheel which gives superior finishes. Due to the nature of this softest bond its speed is limited to 3,000 sfpm. This wheel, the Manhattan, is designed for finishing on stainless steel, glass, non-ferrous and precious metals. It is supplied in the finer abrasive grain sizes or with pumice, rottenstone or other mild abrasives and is very effective in blocks and rubbing pads as well as in wheel form.

For further information write the company as above.

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a soluble buffing compound that removes readily from buffed surfaces.

Wyandotte Buffing Compound—specifically designed for zinc base die castings and aluminum—eliminates the labor and costs of vapor degreasing and emulsion pre-cleaning . . . and gives excellent results in cutting and coloring operations.

Shown above are two bars of buffing compounds—a Wyandotte bar and a representative competitive bar. Both measure approximately 2″x2½″x8″.

Both bars were given identical treatment—(1) thirty-minute partial immersion in tap water, 125° F. and (2) ten-minute partial immersion in sulphuric acid solution, 2½% by volume, room temperature.

Note the solubility of the *Wyandotte* bar to both water and weak acid solution. The ease with which this Wyandotte compound can be removed should help you with your production problems.

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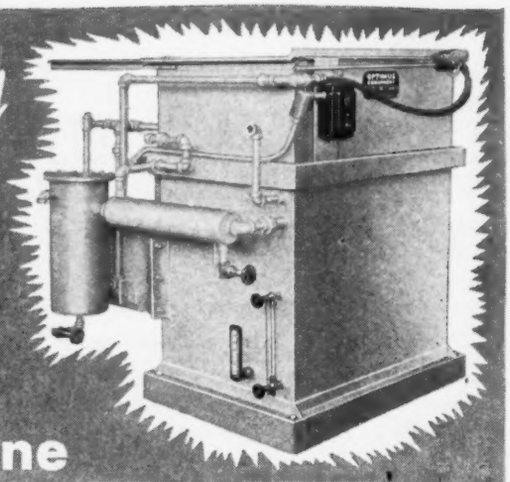
Announcing

a new complete line of Metal Parts DEGREASERS



Type OP-1-40 OPTIMUS Vapor-Spray Type Degreaser. Designed for use with trichlorethylene. Installed to degrease metal parts prior to plating. All parts of unit hot galvanized after fabrication. Heating and cooling coils readily removed. Unit acts as a still to recover salvaged solvent. One of a series of standard OPTIMUS models.

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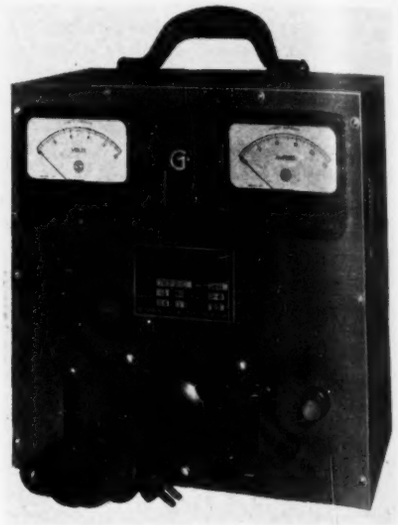
FOR CLEANING · RINSING · DEGREASING · PICKLING AND DRYING OF METAL PARTS

Portable Bench Rectifier

A new portable rectifier unit has been announced by W. Green Electric Co., Inc., 130 Cedar St., New York, N. Y.

It is claimed that this unit, Model No. 725S1C, is the first of its type on the market. The unit has a capacity of 150 watts, incorporates all the manufacturer's standard features, plus exceptionally light weight and portability, thus making it ideal for laboratory and industrial applications, as well as for battery charging, it is claimed.



The cabinet dimensions of the unit are 14 x 14 x 9 inches, its weight approximately 45 pounds. The output is adjustable from zero to 6 volts and has a continuous capacity of 25 amperes.

The rectifier is said to have single-phase full wave circuit, using a quadruple protected selenium rectifier element; convection cooled, with no moving parts; heavy duty rubber cord and plug to match any standard AC outlet; On/Off switch of the magnet circuit breaker type to provide input protection; panel mounted fuse in the DC circuit to provide output protection; continuous range voltage control transformer, from zero to maximum. A large voltmeter, with a designed accuracy rating of 2% full scale, is connected across the output terminals and a matching ammeter indicates output current. Output terminals are color-coded to facilitate connection.

Literature describing this rectifier, and ten larger models of the bench type, can be obtained by writing direct to the company.

Snagging Grinder

The Standard Electrical Tool Co., Dept. MF, 2503 River Road, Cincinnati 4, Ohio, announce that they have redesigned their No. 30 Multiple Speed Snagging Grinder and this is now available in sizes for 18" up to 30" wheels.

The unit is called No. 30 for 30" diameter, 2" to 4" face x 12" bore grinding wheels. There are three spindle speeds so that grinding efficiency may be maintained throughout wheel life merely by changing the spindle speed as the wheels reduce in diameter. Interlocking arrangement prevents overspeeding of the wheels. The heavy duty

ball bearings are fully protected. Liberal size oil reservoirs are fitted with Sight Feed Oil Gauges. Shaft lock for use in changing wheels. Power transmitted to the grinding spindle through multiple V-belt drive. The adjustable sheave on the grinding spindle is conveniently accessible through a hinged cover. The guards are of boiler plate steel, with adjustment to compensate for wheel wear, each fitted with adjustable spark breaker and shatter proof glass eye shield. Adjustable and removable work rest at each wheel. The equipment has 3-step sheave on grinding spindle and motor drive. Furnished to specifications, either for vitrified bond or resinoid bond grinding wheels.

Complete Plating Unit

A new plating unit especially designed for the small manufacturer and service shop has recently been announced. The unit is said to simplify cadmium or other plating processes because of its compactness; it is claimed that a trained operator is not required to operate the equipment.

The unit is stated to be a self-contained plating set, complete with a circuit of transformers and copper oxide rectifiers which convert 110 volts AC to 6 volts DC by means of cable and bus bars. The welded steel plating tank measures 12" wide, 24" long and 15" deep. Parts being plated are hung in the plating solution from hooks suspended from cross-pieces designed for maximum contact surface and movable along the length of the tank by means of a sliding contact.

The ammeter range is 0 to 30 amperes and is controlled by means of a tap switch, both mounted together with the main toggle switch on the instrument panel built into the face of the unit.

The plater requires a floor space of 25"x25", while the overall height is 36". No installation, other than to plug in the line cord into a 110 volt AC supply is required, according to the manufacturer.

The unit is available by writing to the D. C. Cooper Co., Dept. MF, 1467 S. Michigan Ave., Chicago 5, Ill.

Hammond
OF KALAMAZOO

COSTS A LITTLE MORE...
WORTH A LOT MORE

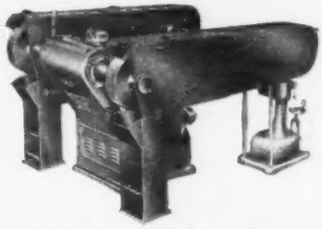
The HAMMOND No. 3 Backstand will convert any standard Grinder or Polisher into a high production abrasive belt unit.

Note these "plus" features:

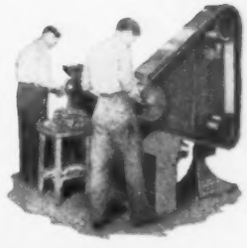
+ Patented spring loaded adjusting screw and hand wheel — maintains uniform belt tension while in operation. Tension easily and quickly adjusted.
+ 12" diameter by 7" face ball-bearing balanced pulley.
+ Front Control — operator can track belt at front of lathe.
+ Heavy machine tool construction — so important for smooth operation. Net weight 375 lbs. Gross weight 450 lbs.

Built by America's leading producer of Grinding and Polishing (including Automatic) Machinery.

Write for Bulletin No. 315.



HAMMOND "VRO" Variable Speed (1500 to 3000 RPM) Polishing and Buffing Lathe with two No. 3 Backstands.



HAMMOND "VRO" Variable Speed (1500 to 3000 RPM) Polishing and Buffing Lathe with No. 4 Backstand.

IN OPERATION AT BOOTH A-138, NATIONAL METAL CONGRESS, ATLANTIC CITY, NOVEMBER 18-22.

Hammond Machinery Builders INC.
1601 DOUGLAS AVENUE • KALAMAZOO 54, MICHIGAN

The camel's ability to withstand desert's stifling heat and burning sands has nothing on BUNATOL 785 for standing up against hot alkali cleaners, strong acid and alkali solutions in decorative plating . . . Copper, Nickel and Chrome.

Plating racks and fixtures insulated with BUNATOL 785 stand the rough handling they often get these days just as the camel stands up under days of tough going without food or water.

A generous sample of this heavy-bodied, free dripping liquid insulation that can be handled with less labor cost awaits your request.

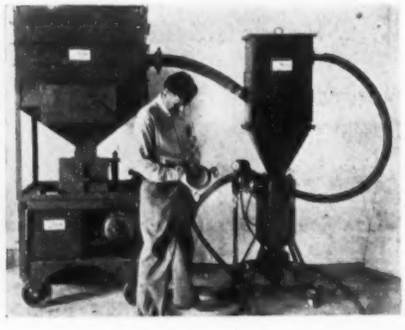
NELSON J. QUINN COMPANY · TOLEDO 7, OHIO

BUNATOL 785

Vacuum Type Blaster

The Vacu-Blaster, new blast-cleaning device that is said to revolutionize methods of cleaning or refinishing metal, concrete, or other hard surfaces, is now in production by the Vacu-Blast Co., Inc., Dept. MF, 1054 Broadway, Burlingame, Calif.

Unique feature of the equipment is its vacuum return system, which is claimed to permit no abrasives or other particles to escape into the open. Operated in much the same fashion as a household vacuum cleaner, the machine may be used without masks, goggles, or protective clothing, it is claimed. The vacuum pick-up system is so designed that precision machinery, food products, or other objects of value need not be removed or covered, although they may be adjacent to the blasting operation, according to the manufacturer. Spent abrasive is reclaimed by the unit and re-used as long as it remains effective.

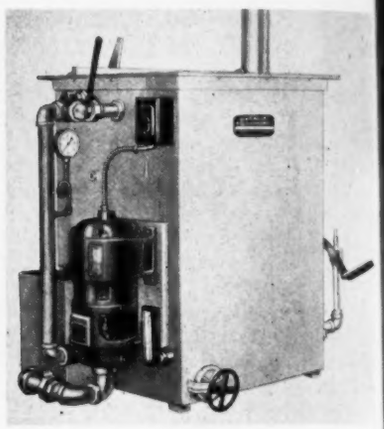


Operation of the blaster is said to be predominantly automatic. The blast is controlled by a switch at the gun through which the abrasive blast is directed and through which grit and dust are picked up. The vacuum system operates continuously, returning grit and refuse to the reclaiming tank, where re-usable grit is returned to the blasting system while dust and refuse are shunted off to a dust collector. Reclaimed abrasive is automatically dumped into the grit-supply tank at the close of each operating cycle. At the same time, the blasting assembly is automatically flushed with clean air to prevent the possible clogging. Loading of fresh abrasive into the machine is accomplished by the vacuum system, which picks up the grit through the blasting gun from a container on the floor.

Spray Type Washer

A new spray type washing machine for the quick and thorough washing of parts on racks has been announced by the Optimus Equipment Co., 127 Church St., Matawan, N. J., manufacturers of washing and drying equipment.

The machine can be placed directly on the floor without pit or cement work. The top of the unit is at working height, and all connections are designed to be readily accessible. The lever operated valve is claimed to make starting of the spray easy; spray nozzles are adjustable and replaceable. The same machine can be used with submerged agitation to remove caked greases, such as tripoli compound and abrasives.



The machine is said to eliminate slow and laborious hand-cleaning of small metal parts. It can be used individually, or in series where the washing operation requires several steps, for example: solvent wash, rinse, alkali wash, second rinse; all of which operations are claimed to be performed with the washer.

Marking and Code Dating Machine

Adolph Gottscho, Inc., code dating and marking machine specialists announce a new addition to their equipment. This is designated Marcomatic 39C.

This machine incorporates new interesting features. It is portable, adjustable, complete and easily adaptable. The machine is portable on a single caster in its base for marking operations in different locations from day to day; it is adjustable in all three planes for carton size variations. It stands on the floor and is complete in having its pedestal, column and switch, and is adaptable to mark objects on almost any conveyor and packaging or material handling machine on the market.

For further information and specifications write to Adolph Gottscho, Inc., Dept. MF, 1 Hudson St., New York 13, N. Y.

Dust Collector

New improvements in the Model 1150 Dustkop dust collector, which are designed to increase its efficiency under the extremely heavy dust loads peculiar to production buffing and polishing work, are announced byGet-Detroit Co., Dept. MF, First National Bldg., Ann Arbor, Mich.

Though still retaining the combination of cyclone separator and spun glass filter as

first and second stage air cleaners, three changes have been made: a high compression filter, a new type filter seal and cyclone stack deflector have been added.

The high compression filter is said to have the effect of stopping all the particles of lint and polishing dust at its surface rather than permitting partial entry into the filter as in the case of dry grinding dusts which could be shaken out by the hand crank.

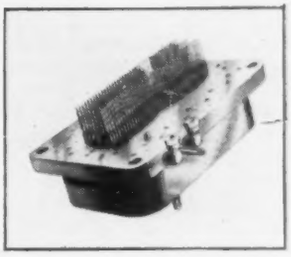
While the additional pressure created by the use of the higher compression filter is difficult to measure with standard air measurement instruments, a sponge rubber seal at the filter edge has been added to insure effective seal at all times. A deflector which is positioned at the outlet of the cyclone stack is designed to distribute the dust laden air uniformly so that there is no direct stream of air against any single area of the filter, thereby permitting the mat of lint to form evenly and uniformly over the under side of the filter.

12,000 Holes per Hour! With New Gearless Multiple Spindle Drillhead!

The Zagar Gearless Drillhead can accommodate up to 400 drills in one head—drill up to 400 holes at one time! This revolutionary unit runs noiselessly and vibration-free on needle, tapered roller and precision ball bearings, and is lubricated by a patented automatic oiling system to insure trouble-free operation.

With this unit all holes are drilled at one pass, and valuable time is saved by the elimination of indexing and extra handling. It may be used on standard drill presses, or furnished as a complete hydraulic machine by the factory.

Another time saver, as well as a help on a tedious job, is chewing gum. The simple act of chewing seems to make the work go faster, easier—helping to relieve worker's fatigue—so that a better piece of work can be turned out with greater safety. Wrigley's Spearmint Gum may be used even when both hands are busy—right where the work is being produced.



Zagar 220 Spindle Gearless Drillhead

You can get complete information from
Zagar Tool, Inc.
23881 Lakeland Blvd., Cleveland 17, Ohio

AA-98

Business Items

CYREX BECOMES CONSULTANT

Announcement is made of the formation of an electroplating engineering consultant agency by *F. G. Cyrex*, Dept. MF, P. O. Box 266, Kalamazoo, Mich. Mr. Cyrex will also operate as a Manufacturers' Agent, representing lines of the leading manufacturers of polishing and plating equipment.

Mr. Cyrex had disposed of his interest in the *Kenart Mfg. Co.*, before forming the new agency.

PENNSALT NAMES COLLINS

The appointment of *George T. Collins* as manager of the Market Research Department of *Pennsylvania Salt Manufacturing Co.* has been announced by *Richard L. Davies*, assistant to the president. Mr. Collins, formerly a chemical engineer in the department, was assistant manager of Market Research when he was promoted. He joined the organization October 15, 1943.

Pennsalt's Market Research Department was one of the first in the chemical industry. Among the new things it is doing are the preparation of economic information for sales forecasting and the application market research in guidance of scientific research.

UNITED CHROMIUM OPENS NEW PLANT

A large, modern lacquer plant was opened in Carteret, N. J., recently by the Organic Coatings Division of *United Chromium, Inc.* This new plant is located among the buildings of the Metal and Thermit Corp., of which United Chromium is a subsidiary. It replaces the lacquer plant formerly operated in Waterbury, Conn. In designing the structure, emphasis has been placed on efficiency, safety and simplicity of operation with provisions made for future expansion as business continues to increase.

Main floor and mezzanine type of manufacturing is a feature of the plant. Raw materials are lifted to the mezzanine by a crane and an electrically-driven hoist from

How to improve metal products through better finishes

Here is a book that answers all the questions on finishing metal products and shows the methods, techniques, and cost factors in producing them. The sales value of attractive metal finishes and the effect of color are also covered in this practical, profitable book.

352 *pages*
5 x 8
135 *illustrations*
$4.00

New Second Edition describes all recent developments in this field.

FINISHING METAL PRODUCTS

By HERBERT R. SIMONDS and ADOLPH BREGMAN
Consulting Engineers

A COMPLETE PRACTICAL MANUAL covering usual types of finishing-galvanizing, polishing, plating, lacquering, painting. Also discusses fully such subjects as use of color, and production and use of color, and production and use of prefinished materials.

COVERS FINISHING from a business and sales standpoint. Deals with methods that improve results and reduce costs. Helps you determine types of finish with greatest sales appeal.

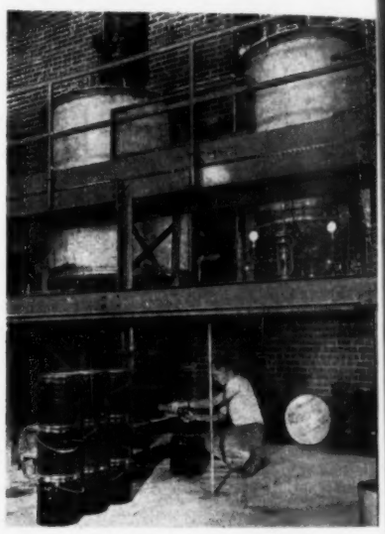
EXPLAINS SHOP TECHNIQUES. Tells how to reduce polishing and buffing costs. Gives techniques for cadmium plating, chromium plating, spray coating. Tells how to use enamels and lacquers in metal parts production.

This up-to-date, handy manual should be at the finger-tips of plant managers, superintendents and foremen. Send your remittance of $4.00 today to

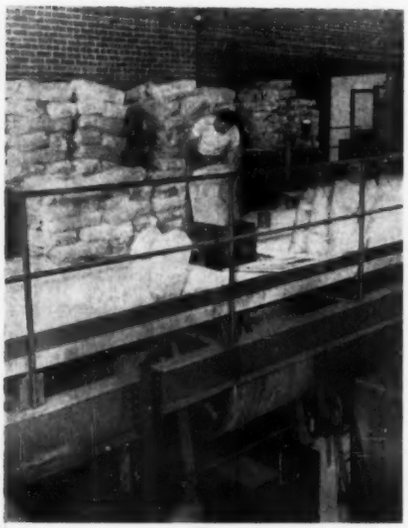
Partial List of Contents
Sales Value of Attractive Finish
The Problem of Selection
Importance of Color
How to Minimize Cleaning Expense
Recent Developments in Plating
Metal Coloring
Preparation for Paint
Painting for Protection
Synthetic and Novelty Finishes
Special Finishes

METAL INDUSTRY PUBLISHING CO.
11 WEST 42ND STREET NEW YORK 18, N. Y.

Load of lacquer paste being released into high speed mixers, to be followed by solvents and mixed into a uniform lacquer.



Finished lacquers being packaged directly from high speed mixers into drums or pails.



Dry resins and other ingredients being weighed and poured into pebble mills for grinding into lacquer paste.

Mixed lacquer paste being released into rolling floor tanks and then into drums for temporary storage.

where they are fed into the pebble mills. The mills are unloaded on the main floor. All floors in this manufacturing section are of the sparkproof and conductor type.

A large portion of the volatile solvents are stored in five 5,000 gallon outdoor storage tanks. They are pumped directly to transfer tanks placed on the weighing platform in the mixing room. After the transfer tanks have been filled, they are transported to the mixing tanks by a sixty-foot-span overhead crane.

The plant includes a testing laboratory, air-conditioned laboratory, general research laboratory, heavy equipment laboratory, analytical laboratory and service laboratory. The testing laboratory includes such equipment as a six-foot water-wash spray booth, a six-foot drying room, a lacquer dipping machine, a large infra-red drying bank, a salt spray testing cabinet, and a humidity cabinet. The air-conditioned laboratory is equipped for close control of the humidity as well as the temperature.

The new plant will be managed by *F. L. Scott*, who has been managing the Waterbury

plant since 1944. *A. E. Whitney*, who was with *DuPont* for five years, has been named production manager. The supervisor of technical service is *D. R. Meserve*, who formerly held the same position at Waterbury.

At the dedication ceremonies, it was pointed out by *R. O. Loengard*, president, that United Chromium originally entered the lacquer field to meet the demands for better organic coatings in the electroplating industry. From this small beginning, the demand for the company's products has become so great that the Waterbury plant has been unable to handle the increased production demands. The result is the new Carteret plant.

BROWN EXPANDS STAFF

A group of 45 new sales and service engineers have been added to the expanded field staff of the *Brown Instrument Co.*

"The addition of 25 sales engineers and 20 service men," according to *W. H. Steinkamp*, field sales manager of the industrial division of *Minneapolis-Honeywell Regulator Co.*, "is further evidence of the overall growth and expansion of our activities."

The group of 45 sales engineers and service men will be assigned, about the first of the year, to various regional offices and branches throughout the country, said Steinkamp. All of the men are now attending the Brown Company School of Instrumentation at Philadelphia.

MICHIGAN CHROME NAMES RUSS

George H. Russ was recently appointed Sales Manager for the Chemical Division of *Michigan Chrome and Chemical Co.*, 6340 E. Jefferson Ave., Detroit 7, Mich. Prior to this appointment in 1942, Mr. Russ was sales manager of the Plating Division, and this experience has served as a valuable background for the aggressive sales policy of the company during the last few years. In co-operation with *Mr. O. H. Leidy*, president, distributorships covering the United States and Canada have been established, together with field representatives serving as assistants to Mr. Russ. All the company's products for the plating industry are said to be the development of their own research engineers and tested under actual production conditions in their own plating plant before they are offered to the industry generally. Mr. Russ attended the Engineering School of Michigan State College and was formerly employed by the *Detroit Edison Co.*

George H. Russ

CARBIDE NAMES JOSLIN

Richard M. Joslin was recently appointed manager of the Detroit Office of *Carbide and Carbon Chemicals Corp.* and took over his new post on September 3, according to an announcement by company officials. Mr. Joslin has been with the Corporation since 1935. He served as a technical representative in the Philadelphia area and for the past two years, has been manager of the Charlotte, N. C. office. He will replace *George D. Garrett, Jr.*, Detroit district manager since 1940, who is joining Carbide and Carbon Chemicals Ltd., in Toronto, Canada.

DOLLINGER INSTRUCTS SALESMEN

Thirty sales representatives of the *Dollinger Corp.*, from every section of the United States, including the West Coast and Texas, got a preview of new designs of *Stayneu* filters at a three-day sales conference September 20, 21 and 22. The conference was held at the company's Rochester plant and at Longue Vue, Thousand Islands.

Inspection of the plant and study of manufacturing processes were followed by examinations of new models of filters for air, other gases and liquids. These included special high-pressure and high-temperature pipe line models and large-capacity automatic filters for ventilating systems.

L. L. Dollinger, Jr., addressed the group on "Ventilation Filters" and *K. E. Ellis* of the sales department spoke on "Industrial and Liquid Filters."

"U.S." Acid-proof Tile or Brick, bonded with "Vitric-10" quick-setting, chemical-hardening, acid-proof cement, is the ideal combination for chrome plating tanks. No membrane is required between the steel shell and the tile or brick. Construction is quick, easy and economical. "U.S." Brick or Tile Linings are proof positive against corrosion, eliminate any chance of stray currents, last indefinitely.

YOU CAN INSTALL "U.S." TILE LININGS YOURSELF WITH OUR EASY-TO-FOLLOW INSTRUCTIONS

FREE BOOK
The most complete book on acid-proof masonry construction ever prepared. 56 pages full of facts, helpful information, design details, etc. We'll be happy to send you a copy, absolutely free. Write today and ask for a copy of Bulletin 810MF.

OR, IF YOU PREFER, WE CAN FURNISH THE COMPLETE TANK INSTALLED

U. S. STONEWARE
Since 1865 • Akron, Ohio

FOXBORO ERECTING CANADIAN PLANT

Foundation work is under way for the new plant which *The Foxboro Co., Ltd.*, is erecting on a three and one-half acre site in the Ville LaSalle section of Montreal. The completed building will be turned over to the owners in the Spring of 1947, ready for immediate occupancy.

The new plant, of brick and steel construction, will consolidate machining, metal finishing, and other basic operations, as well as the assembly and calibration of instruments, on one floor level. Adequate window area, as well as saw-tooth skylights facing north, will insure uniform light distribution. One department, specially air conditioned, will be devoted to the printing and storing of recorder charts. The plant site is adjacent to that of *Peacock Bros., Ltd.*, sales and service agents for Foxboro Instruments in Canada and Newfoundland.

PENNSALT SHIFTS TWO SALES CHIEFS

Louis M. Kuilema, formerly district sales manager at the Cincinnati office of *Pennsylvania Salt Manufacturing Co.*, has been placed in charge of the Wisconsin territory as district sales manager. On October 1 he moved to permanent headquarters at 20 N. Wacker Drive, Chicago, from his temporary office in Minneapolis, according to an announcement by *George B. Beitzel*, Pennsalt's vice president in charge of sales.

Charles W. Dermitt has been moved to Cincinnati as Mr. Kuilema's successor after four years as assistant to *William P. Snelsire*, Pittsburgh district sales manager.

M-B TO HANDLE IRIDITE

The *Mitchell-Bradford Chemical Co.*, Dept. MF, 2446 Main St., Stratford, Conn., has been appointed exclusive distributor for the sale of *Iridite* in the New England area by *Rheem Research Products, Inc.*, manufacturers of the Iridite process. The area granted to the company includes the states of New York, Connecticut, Rhode Island, Massachusetts, Maine, New Hampshire and Vermont.

ATLAS FORMS AFFILIATE

The Atlas Mineral Products Co., manufacturers of acid- and alkali-proof cements, acid- and alkali-proof floors, plastic linings, jointing materials and protective coatings, announces the formation of an affiliate organization, *The Atlas Mineral Products Co. of Texas, Inc.*, located at Houston 1, Texas.

The new affiliate organization includes a manufacturing plant for sulphur cements and other firm products and handles the sales of Atlas products in the territory west of the Mississippi with the exception of Minnesota, North Dakota and eastern Missouri. It will also handle sales in western Tennessee, Mississippi and Louisiana.

CAMPBELL NAMED EXECUTIVE SECRETARY

A. B. Campbell, formerly eastern representative of *Hughes Brothers* has accepted the position of executive secretary of the *National Association of Corrosion Engineers*, with headquarters in Houston, Texas.

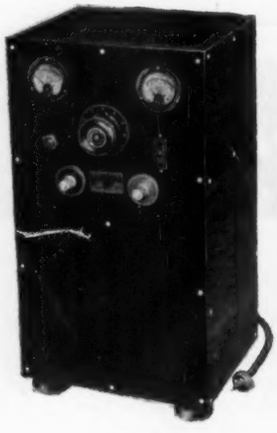
Mr. Campbell is a graduate in electrical engineering of the University of Illinois and also has the professional degree of Electrical Engineer from that school. From 1915 to 1920 he was on the faculty of the Engineering Extension Department of Iowa State College. From 1920 to 1923 he served as electrical engineer on the Iowa Board of Railroad Commissioners. He was an engineer on the headquarters staff of the N.E.L.A. and the E.E.I. from 1923 to 1943, at which time he joined Hughes Brothers. The new executive secretary is a fellow of the A.I.E.E.

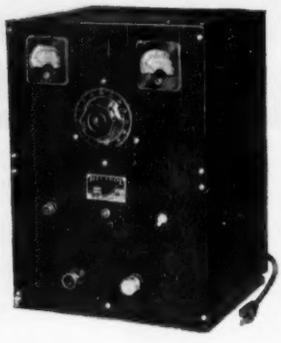
FULMER JOINS PENNSALT

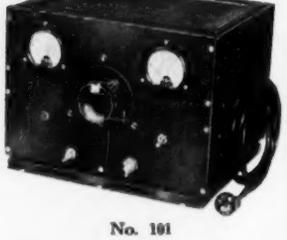
Joseph H. Fulmer, formerly connected with the *Ethyl Corp.* and *Sharples Chemicals*, has joined the engineering department of *Pennsylvania Salt Manufacturing Co.*, it is announced. Mr. Fulmer was born in Port Allegany, Pa., and in 1923 was graduated from Bucknell University as a chemical engineer.

Outstanding Values in CONTINUOUSLY VARIABLE "RECTROL" PLATING RECTIFIERS!

EFFICIENT, ECONOMICAL D.C. POWER SUPPLY







No. 103 No. 102 No. 101

"RECTROL" Plating Rectifiers offer you the following advantages:

- **VARIABLE D.C. VOLTAGE**—From zero to maximum available by rotating large knob located on front panel, and selected voltage is indicated on large (3½") D.C. Voltmeter.
- **ECONOMICAL TO OPERATE**—Conservatively rated. Standard parts of best quality used.
- **CONSTRUCTION FEATURES** are of custom-built quality, and include the following: — (a) Convection cooled, conservatively rated selenium rectifier . . . (b) Powerstat—continuously variable voltage control from zero to maximum . . . (c) DC Ammeter to indicate output current (size 3½") . . . (d) Voltmeter to read output DC Voltage (size 3½") . . . (e) Panel mounted fuse . . . (f) On and Off switch . . . (g) Pilot Lamp . . . (h) Rubber cord and Plug.

SPECIFICATIONS

Model	Input	Output	Capacity	Overall Size	Approx. Ship. Wt.
#101	115V., 60 cyc.	12V DC	25 amps.	10" x 14" x 11¾"	50 lbs.
#102	115V., 60 cyc.	12V DC	50 amps.	20" x 14" x 11¾"	75 lbs.
#103	115V., 60 cyc.	8V DC	150 amps.	28" x 16" x 13½"	150 lbs.

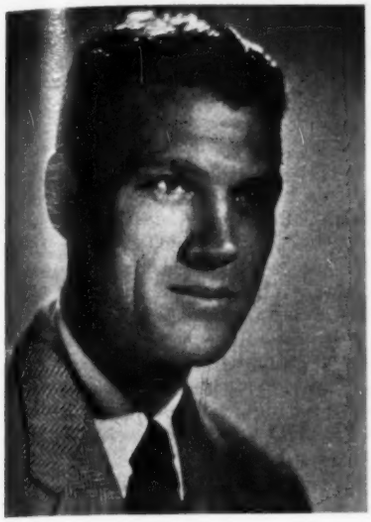
All models are continuously variable — Other Plating Rectifiers Made to Order! — WRITE FOR BULLETIN "R"

ELECTRO-TECH Equipment Co.

119 LAFAYETTE ST., NEW YORK 13, N. Y.

H-VW-N APPOINTS BOSL

The Hanson-Van Winkle-Munning Co. announces the appointment of *Eugene C. Bosl* as a sales representative. He is now located in the Milwaukee office of the company, after an intensive training program at Matawan.



Eugene C. Bosl

Mr. Bosl is a graduate of the Milwaukee State Teachers College, with the degree of Bachelor of Education in Chemistry. Prior to coming with the company, Mr. Bosl served as a lieutenant in the U. S. Navy and before the war he was an instructor in chemistry at the Milwaukee Vocational School.

PENNSALT SENDS MEN TO EUROPE

Walker Penfield, manager of manufacturing of the *Pennsylvania Salt Manufacturing Co.*, has sailed for Europe for a two-month visit of chemical companies in England, France and Denmark.

He will be joined later at the *Cryolite Co.* in Copenhagen by *Cyril Hayward*, chief chemist of the Pennsalt plant at Natrona, Pa. The trip is being made for the purpose of studying new manufacturing processes and for exchanges of technical information with the European chemical companies, Mr. Penfield said.

ZIALITE CHANGES ADDRESS

The *Zialite Corporation* announces a new location for its office and factory as of November 1st. The new address is 92 Grove Street, Worcester 5, Mass.

New Books

The Metallurgy of Quality Steels, by Charles M. Parker, published by Reinhold Publishing Corp., 330 W. 42nd St., New York, N. Y., has recently been released at a price of $6.00.

The contents follow the usual metallurgical textbook pattern, explaining the various manufacturing methods and practices. Inspection and testing methods are reviewed, and the effects of alloying and heat-treatment of steels is comprehensively interpreted.

A unique feature of the book is a series of case histories. These are given in chronological order with the hour and minute indicated for each operation. Explanations and reasons for each step are also incorporated, and a summary of results tabulated. These case histories cover the following heats: Basic Open Hearth Alloy Steel; Acid Open Hearth Carbon Steel; Electric Furnace Steel, and Bessemer Steel.

The first edition of *Best's Safety Directory* has just been published by Alfred M. Best Co., Inc., 75 Fulton St., New York 7, N. Y., through their Safety Engineering Division; price $5.00.

The directory covers the industrial safety, first-aid, hygiene, health conservation and fire protection fields, and gives essential information on products, devices and equipments used.

The book is cross-indexed and each item in the text briefly states what product to use for a given safety measure, when and how to use it and where it can be obtained.

Volume 20, Journal of the Electrodepositors' Technical Society, Northampton Polytechnic Institute, St. John St., Clerkenwell, London, E.C.1, has recently been published. The editor is S. Wernick and the assistant editor, S. W. Baier; price: one guinea.

This 218-page book contains the papers which were presented at meetings held in London and Midlands Centre during the session 1944-45. Fifteen papers are published covering a broad range of metal finishing processes including silver, lead, tin, nickel, copper and chromium plating; surface treatments for aluminum, steel and

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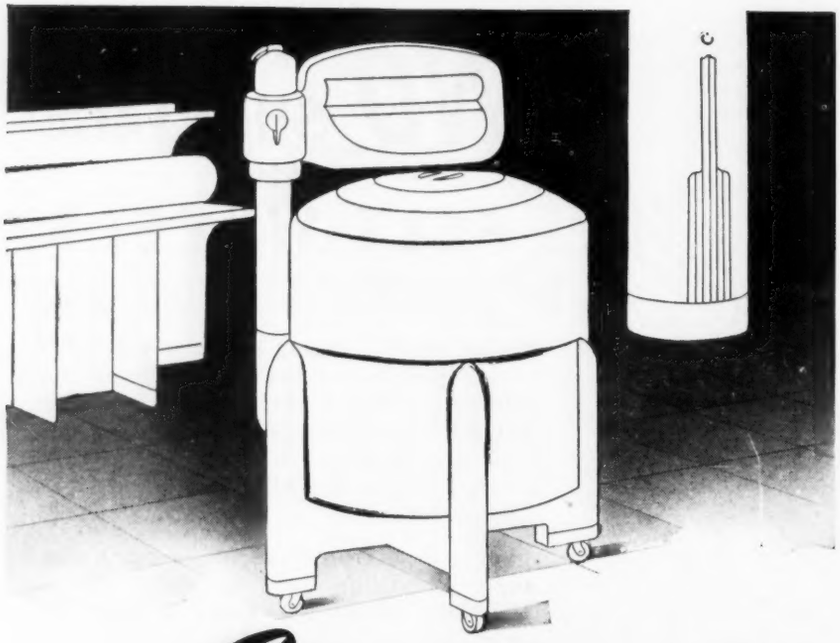

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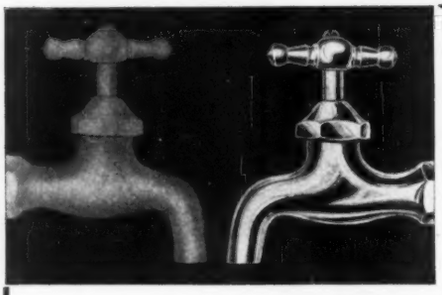

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zinc; stop-off coatings; and a magnetic tester for coatings on steel.

Under the Discussions section, the majority of papers are reviewed and much additional pertinent information is given. Several opinions are advanced and constructive criticism offered.

The book also gives the annual report of the Society as well as a list of the various officers.

—

Scientific Instruments, published by the Chemical Publishing Co., Inc., 26 Court St., Brooklyn 2, N. Y., and edited by Herbert J. Cooper, is a comprehensive book designed to cover instrumentation in the field of physical measurements.

The title belies the text somewhat, for the information given covers not only instruments used in scientific research and general laboratory work, but the various measuring devices used in everyday commerce and industry as well.

Methods of measurement, principles of design and a full description of the various instruments are given. The subject matter is well supplemented with diagrams, sketches and photographs to assist in understanding the application and design of the measuring devices described.

The book is divided into five sections: Optical Instruments; Measuring Instruments; Navigational and Surveying Instruments; Liquid Testing, and Miscellaneous. Chapters under the Miscellaneous section cover acoustics, calculating machines, hardness indicators, vacuum tubes and thermionic valves.

The price of this book is $6.00.

Manufacturers' Literature

Idler Backstands

Idler backstands and lathes for belt polishing are described in a new pamphlet available from the *Divine Brothers Co.*

Illustrated are the DB-3 backstands in various sizes with the manufacturers features explained. These include visible belt tension indicator, front belt tracking control, spring pressure control of belt tension and self-adjusting control rod for belts up to six inches wide.

Also shown are both standard and heavy-duty polishing lathes for use with backstand idlers. The standard line is available in 5 and 7½ hp drive units while the heavy-duty lathe may be had with 5, 7½ or 10 hp motors. Standard specifications are included in all the equipments described.

Copies of this and other booklets may be obtained by writing to Divine Brothers Co., Dept. MF, Utica 1, N. Y.

Filtering Equipment

A handsome 44-page booklet has recently been released by the *Dollinger Corp.*, Dept. MF, 11 Centre Park, Rochester 3, N. Y. The company are manufacturers of filters and filtration equipment.

Equipment and material for filtration of air and other gases, liquids, chemicals and special applications are illustrated and explanatory data listed. Recommendations for

installation are given for each type of equipment made; specifications and ratings are also shown. The various filters are photographed in cut-away views, showing actual operating conditions.

To secure a copy of this booklet, write on company letterhead to the address above.

Horizontal Plate Filters

A new folder explaining their line of horizontal plate filters has recently been released by the *Sparkler Manufacturing Co.*, Dept. MF, Mundelein, Ill.

The leaflet describes in detail the various features of horizontal type filtration. Claims made include greater efficiency because of the gravity held cake, due to the filter media being supported in a horizontal plane, plus ease in handling. Cross-sectional sketches illustrate the principles involved. Models and range of application are listed, together with specifications and other pertinent information.

The leaflet is available by writing the company.

Corrosion-Resistant Equipment

Corrosion-resistant parts and equipment for the process industries are described in a new illustrated booklet published by the *General Ceramics and Steatite Corp.*

Cut-away photos show standard chemical stoneware towers, filters, tanks, heat transfer coils, pumps, and acid elevators for handling acids and other corrosive materials. Chemical stoneware fittings including pipe, spigots, tees, valves, and elbows are also illustrated and described.

Text of the booklet outlines processes in which chemical stoneware is used for handling such corrosive materials as hydrochloric and nitric acids where mechanical strength and thermal shock are factors. Various packing tower rings are evaluated according to absorption coefficient, and methods of packing tower construction are described and illustrated. Uses of special chemical porcelains for pipes, fittings, porous diaphragms, and tanks are included.

Copies of the booklet, *Bulletin CHE-RI*, can be obtained from: General Ceramics and Steatite Corp., Chemical Equipment Division, Dept. MF, Keasbey, N. J.

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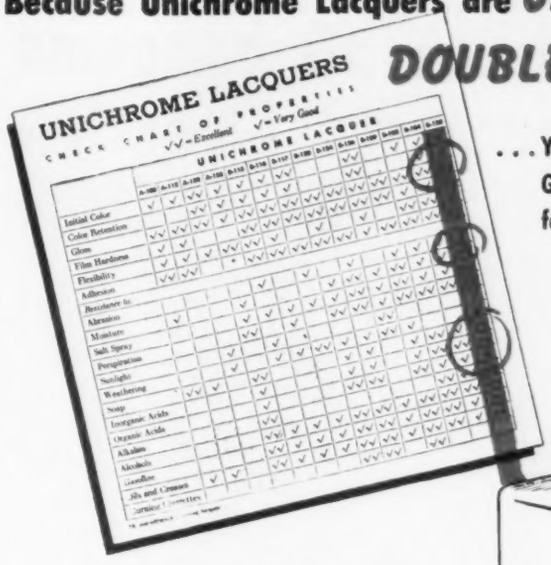
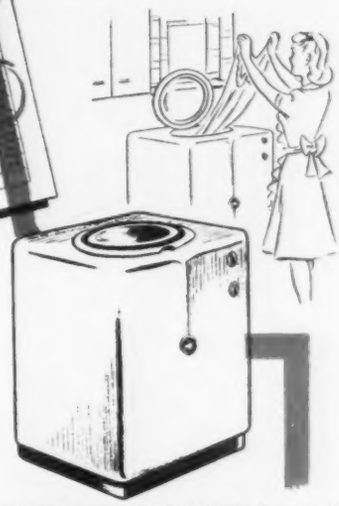


. . . You Can Be Sure of Getting the Right Finish for Your Product!



BEFORE YOU DECIDE on a finish for your products, jot down—in order of importance—the properties the finish should have. Then consult the convenient check chart above. Chances are that, among the 14 standard Unichrome lacquers listed, you can find exactly the finish you want—checked (very good) and double-checked (excellent) for its ability to stand up under specific service conditions.

And remember that intensive research and experience stand back of every Unichrome coating. Only highest quality materials go into their formulations . . assuring you uniform results and performance. It will pay you to investigate Unichrome lacquers. We'll be glad to send you *full size* copies of the check chart, together with information on typical uses and methods of applying. Write today to your nearest Unichrome office.

CONSIDER THIS WASHING MACHINE, for example: For durability, for a white that *stays* white, for resistance to water and soap solutions...it requires a finishing coat with high gloss, hardness, color retention, and chemical inertness. That's a fairly complex combination—and yet the right lacquer is *immediately apparent* from the "check chart." B-135 is checked (very good) and double-checked (excellent) on all these important characteristics. Here is a *standard*, unprimed finish that is meeting the special tests of washing machines, kitchen cabinets and other similar equipment . . . to provide a better product with a longer service life.

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Backstand Belts

A new 12-page booklet illustrating their abrasive backstand belts as well as segment face contact wheels is available from the *Minnesota Mining and Manufacturing Co.*, Dept. MF, St. Paul 6, Minn.

Pictures show abrasive belts mounted on various polishing and buffing machines equipped with backstand idlers. Grinding and polishing techniques for finishing of welds on armor plate, bars, billets, sheets and tubes by means of semi-portable resilient backstand idler equipment are described. The segment face contact wheel developed by the firm has a soft, yielding layer of material at the center and a hard segmented outer face. It is claimed that with such a wheel and the proper belt, uniform polishing of both flat and contoured surfaces can be done.

Copies of the booklet may be had by writing the company as above.

Insulating Coatings

Now available are a series of new pamphlets illustrating and describing the *Miccroproducts* line of stop-off lacquers, air-dry rack coatings, tape and tube materials for masking plating racks, and other corrosion-resisting synthetic coatings.

The stop-off lacquers are available in red or black and are claimed to have exceptional adhesive qualities with high dielectric strength for sharp demarcation lines. The material is used for selective masking of parts in acid baths. The air-dry rack coatings and tape and tube materials are designed for use in insulating plating racks as well as in all plating, anodizing, parkerizing and bonderizing cycles. Complete application instructions are given in the booklets and price lists included.

To obtain this literature write to *Michigan Chrome and Chemical Co.*, Dept MF, 6340 E. Jefferson Ave., Detroit 7, Mich.

Plant Coloring

Du Pont Color Conditioning for Industry, a new 32-page booklet illustrated in full color, is available on request to the Finishes Division, Dept. M-6-MF, Wilmington 98, Del.

Illustrating and describing years of research and practical experience with color to increase production, improve seeing conditions and create a better working environment, the booklet makes clear the fundamental principles on which color conditioning is based.

The "Three-Dimensional Seeing" treatment of machines is depicted with photographs of actual installations. The Safety Color Code for Industry is also outlined. Color Conditioning is shown at work in plants of several well-known companies. A coordinated functional color program for an entire plant is illustrated in a double-page cutaway drawing.

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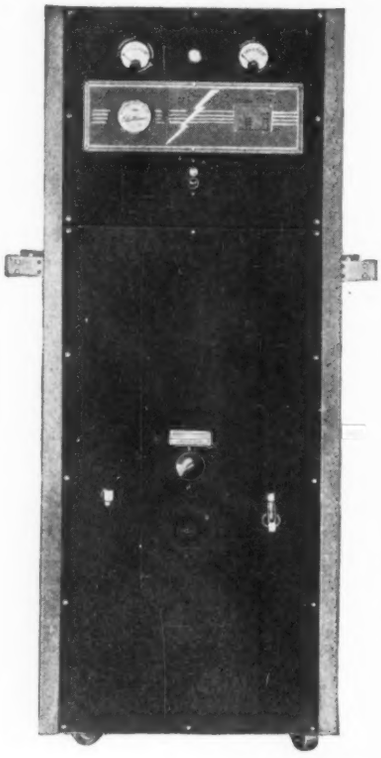

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Boiler Cleaner

"What, Why, Where, How?", is the title of a new 8-page leaflet just prepared by *Wyandotte Chemicals Corp.* listing the uses of their boiler compound and methods of application. The leaflet answers the questions asked in its title with diagrams, charts and written instructions. Copies may be obtained by writing Wyandotte Chemicals Corp., Dept. MF, Wyandotte, Mich.

Process Control Instrument

Bulletin 381, now being distributed by *The Foxboro Co.*, Foxboro, Mass., describes the Model 40 Controller, the newest addition to the company's line of instruments for process control. Large illustrations, accompanied by appropriate text, explain the many features of design which make the Model 40 virtually a wholly new instrument, in design and construction.

The operating-panel feature of *Stabilog* control instruments is shown, and the convenience of operation of maintenance of the Model 40, achieved through unit construction and assembly, is well illustrated. Indicating models, as well as single- and multiple-pen recorders are shown, and the five types of control action available in the instrument are explained.

Copies of the bulletin will be sent on request.

Buffing Lathes

A new 16-page catalog has just been released by *The Bridgeport Safety Emery Wheel Co., Inc.*, Dept. MF, Bridgeport, Conn. It contains information about the various type grinders, buffing lathes and grinding wheels manufactured by the firm.

Illustrations and explanatory material are given on the buffing equipment made. A general purpose lathe has four sets of ball bearings which are said to be housed in dust proof containers. The heavy duty lathe shown has a twin motor drive and is overhung for swinging of heavier work.

The booklet is available by writing to the Company for *Catalog* 146.

Rectifier Equipment

A new 8-page bulletin illustrates and describes in detail the various types of standard selenium rectifier equipment for direct current requirements.

Construction features of rectifier stacks are explained, and information on efficiency, regulation and operational conditions is given. Complete specifications with ratings are listed, and diagrams of the six common circuits used by the manufacturer are included.

A copy of the bulletin may be obtained by writing the *Radio Receptor Co., Inc.*, Selenium Rectifier Division, Dept. MF, 251 W. 19th St., New York 11, N. Y.

Leather Packing Guide

A new Hydraulic and Pneumatic Leather Packing Guide has just been published by *Alexander Bros.*, fabricators of leather packings.

The attractive 20-page booklet contains data covering usage, types, sizes, tables of applications, dimensional standards. It in-

cludes a specimen data sheet for ordering leather packings and information concerning installation and maintenance of this type packing. The standard price list adopted by the leather packing industry is shown. Inquiries about the new guide should be addressed to Alexander Bros., Dept. MF, 406 N. Third St., Philadelphia 23, Pa.

Heat Exchangers

"*Condenser Tubes*" is the title of a new brochure just off the press prepared by *Wolverine Tube Division*, Dept MF, of the *Calumet & Hecla Consolidated Copper Co.*, Detroit. Included are several tables designed to help users of condenser tubes select most efficient materials for their operating equipment. It tells about copper, brass, and copper base alloys and their chemical and physical characteristics as applied to condenser and heat exchange use. It shows a comprehensive graph giving safe working pressures and has two pages devoted to estimating data covering tube sizes from ⅝" to 2" O.D. Several pages are devoted to Wolverine *Trufin*, the integral finned tube. A copy will be sent to anyone requesting it on his stationery.

Terminal Connectors

"*Mechanical Principles of Gorilla Grip Electrical Connectors*" is the title of the new twelve-page booklet *No. 466* now available from *National Electric Products Corp.*, Dept. MF, Chamber of Commerce Bldg., Pittsburgh, Pa.

The new booklet, sized 8½" x 11" and printed in two colors, was compiled to assist engineers, jobbers, contractors and industrial purchasing agents in acquiring an exact understanding of the design and function of these connectors.

Described and illustrated in the booklet are cut-away models and schematic drawings, as well as a factual analysis of the mechanics involved to achieve ample contact area and the permanence of high contact pressure.

The Gorilla Grip electrical connectors and terminal units reviewed are available for sizes 2000 MCM to #2 stranded inclusive.

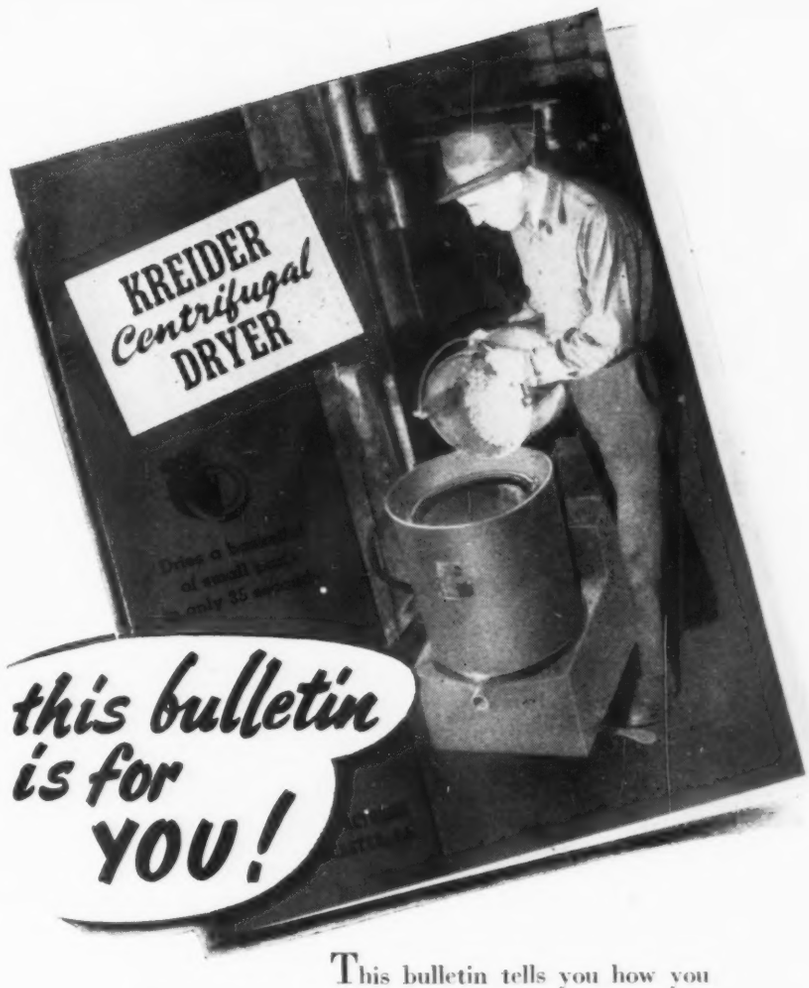
Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

BUFFALO BRANCH

The *Buffalo Branch* of the *American Electroplaters' Society* got off to a good start Friday evening, September 13, 1946, with 30 members present. *Vice-President C. J. Wernlund* was in the chair. *Joe Ruff* was temporary secretary in the absence of *John Kushner*.

Mr. Wernlund started a lively discussion in proposing a class to be formed for instruction in plating solutions. A motion was made by *Bill Hart* and passed that cards be sent out to members for specific answer. The



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meeting was very much in favor of such a class. The only stipulation appeared that it should be held where members could smoke.

Plans were made to attend the Rochester Branch picnic, and above all to lay the ground work for the winning of the celebrated baseball classic or havoc between Buffalo and Rochester. This was done without even a rumor that the Buffalo Bisons might help.

Mr. C. Logan's report of the Pittsburgh Convention was complete and with a few embellishments, such as *Campbell's* soup being served at the *Heinz* Plant.

The meeting learned with regret that Montreal will be unable to be the Convention Host for 1947.

The Sick Committee advised that *Stanley Sharmen* was now recovering at home after a sojourn in the hospital, and all wished a speedy recovery for him.

It was good to see Chris Wernlund in the chair, although he was not able to talk quite as fully as usual. His left arm was still not fully limber from the effects of an automobile accident and he had to talk with only one hand.

The meeting was closed with all feeling that a very active and full year lies ahead.

DETROIT BRANCH

The annual education session of the *Detroit Branch* of the *AES* is to be held at the Hotel Statler on December 14, 1946, at 2 P. M. A symposium is to be held on the manufacture and plating of quality zinc base die castings with a sidelight on European practices with *Carl Heussner* as chairman.

Three talks are to be given as follows:

1. *Manufacture of Quality Zinc Base Die Castings*, by *J. C. Fox*, Chief Metallurgist of Doehler-Jarvis Corp. of New York City.
2. *Plating of Die Castings, including Buffing, Cleaning, Plating and Stripping*, by *Cleveland Nixon* of General Motors Corp., Ternstedt Division.
3. *Testing of Plating on Die Castings*, by *Dr. A. E. Anderson*, New Jersey Zinc Co., Palmerton, Pa.

CHICAGO BRANCH

The regular monthly meeting of the Chicago branch of the *American Electroplaters' Society* was held at the Atlantic Hotel as usual. The attendance was excellent.

Officers of the Supreme Society were very well represented by *Mr. Frank Savage*, supreme president, and *Mr. K. M. Huston*, first vice president.

Mr. John Kreml, research chemist of the Rustless Iron & Steel Division of the *American Rolling Mill Co.*, read a paper on *Electrolytic Polishing of Stainless Steels*. He touched on the historical background of this operation and commented that its initial purpose in 1925 was for preparation of samples for microscopic analysis. Its particular benefit here was found in the fact there was no distortion of the surface due to mechanical working. In addition, the anodic treatment would assure an accurate presentation of the crystalline structure.

Rustless Iron & Steel installed two large commercial plants in 1938. These were for processing wire goods made from stainless

...ed. Although any metal may be processed ...electrolytic polishing at the present time, ...greatest application is still for this pur... Mr. Kreml stated. The great advantage ...using this method of finishing on wire ...ds is that it eliminates many handling ...ficulties that would be encountered in nor... polishing and buffing methods. Another ...nt to be considered is that the surface, ...r electro-polishing, is never contaminated ...h foreign materials as is possible with ...hanical polishing and buffing methods, ...ording to Mr. Kreml.

The author declared that there are two ...tions in general use, the one having low ...stance is used most commonly in com...rcial work. This type employs inorganic ...ds such as sulphuric or phosphoric with ...anic addition agents. The solution which ...s high resistance contains perchloric acid, ...tic anhydride and other components. This ...er solution presents great hazard in its ... Current densities up to 700 amperes ...square foot are common with either type ...solution, he said.

Also, Mr. Kreml stated that there are two ...ories generally considered to account for ...mechanism of electrolytic polishing. One ...that due to the high current densities em...yed, the peaks of the metal are attacked ...st and in this way, leveling of the surface ...accomplished. The other theory presents ...idea that an insulating film protects the ...leys from attack while permitting attack ...the high current areas.

Mr. Kreml touched on various unusual ...es for the process. One was to cut down ...ersize pieces to the required size. Since ...attack is uniform, then all high points ...oversize areas would be removed simul...neously. As an inspection method to check ...tings which were defective as made and ...er filled in by means of welding, electro...ic polishing will cause the patched areas ...show up very clearly, he stated. It also ...an excellent method of insuring plated ...osits to the basis metal. Different solu...ns are used for different metals, he pointed ...t, but in any case, the removal of the ...ilby layer is accomplished, which is a ...rantee of good adhesion.

A very interesting feature of the talk was ...finish, Mr. Kreml had set up a laboratory ...e installation in which he processed sev...al parts submitted by various members.

Both Mr. Kreml and Mr. Huston answered ...merous questions from the floor indicating ...at the interest in this process is well be...nd the experimental stage.

...EWARK BRANCH

The opening session of 1946-47 open edu...tional program of the *Newark Branch* of ...S has just been announced. The first ...eeting is scheduled to be held on Satur...y, December 14th, at 2:30 p.m. at the ...tel Robert Treat, Newark, N. J.

The educational committee in their con...ant endeavor to present good educational ...ograms with a view of obtaining the ut...st in educational value on pertinent sub...ts, are proud to present the following ...t of speakers:

Frank K. Savage, Supreme President, ...ating Room Incentive Systems, Kuehne ...fg. Company, Maldoon, Ill.

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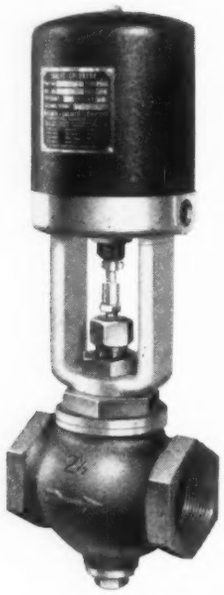

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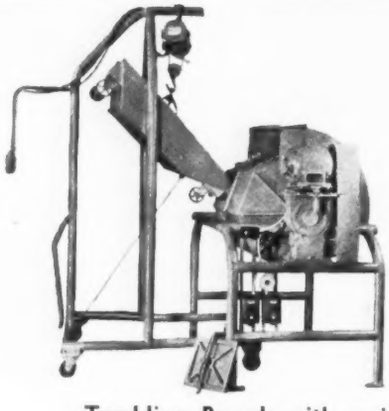

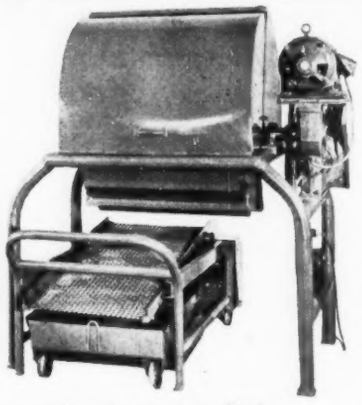

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A ladies committee will entertain the ... iting ladies during the afternoon ses... The afternoon educational session is to... followed by a Christmas Party which ... start at 8:30 p.m.

It has been the custom in the past ... serve a buffet lunch to members and gu... at Christmas Parties, but due to the ... increasing attendance at these parties it ... become impossible to continue this practi...

This year the committee under the Ch... manship of *Horace H. Smith* has decided ... serve a Turkey dinner. This is to be f... lowed by a show and a dance orchestra ... play all evening. Tickets may be secu... and reservations for tables may be m... by contacting *Secretary George Wagner*, ... 4th St., Newark 7, N. J. The price ... admission will be $5.00 per person.

LOS ANGELES BRANCH

The *Los Angeles Branch* of the *Ameri... Electroplaters' Society* held its mont... meeting at the Cabrillo Hotel on the ni... of October 14 with approximately 50 m... bers and 13 guests in attendance.

President D. N. Eldred presided. F... applications for admission into the bra... were approved and the applicants initia... They were *Clarence Weinbrenner* of Gen... *Tire & Rubber Co.; George M. Kent* ... *Kent Co.; Sol Ballonoff* of *Peerless Pla...* *Co.*, who was initiated by proxy; and *W... Behlendorf* of *Spence Electroplating Co.*

Considerable open forum discussion ... held on the advisability of changing ... meeting place of the annual educational ... sion, which for the past several years ... been conducted in the Los Angeles Br... fast Club. Some members advocated ... a more centrally located hall be chosen, ... sibly in the downtown area, whre it w... be equally accessible to all. No action ... taken and the matter was deferred for l... submission to the committee that will han... arrangements for the 1947 educatio... session.

John Merigold reported on negotiati... and discussions that have been held w... representatives of the Newark, N. J., Bra... relative to the 1948 national convention ... the AES which both Newark and Los A... geles are seeking. Mr. Merigold repor... that the Los Angeles Branch had propo... to Newark that the latter withdraw ... application for the 1948 convention in fa... of Los Angeles in view of the fact that ... national conclave of the society had ... been held in the West. Mr. Merigold ... ported that Newark's major contention ... that Los Angeles, being so far remo... from the bulk of the membership, cho... of that city might possibly result in ... meagerly attended conference in 1948. ... Merigold stated that Newark representati... ultimately agreed to withdraw their appli... tion for 1948, with the proviso that New... will again enter the lists should the L... Angeles Branch, for some reason or oth... be compelled to withdraw at a later da...

Announcement was made that *C. G. Spe...*

recently been injured in an airplane dent, but no information was available meeting night concerning the seriousness the injuries he had sustained.

The following guests were introduced: P. Pattenger, president, *San Francisco* ch of the A.E.S. and member of the f of the *A. J. Lynch Co.*, San Francisco. *Milton Norman*, L. H. Butcher Co., Los geles; *LeRoy Chuchton*, Price-Pfister *Myron Orbaugh*, Bone Engineering Glendale; *William Montana*, Modern ting Co.; *Clarence Weinbrenner*, Gen- Tire & Rubber Co.; *Walt Behlendorf*, me Electroplating Co.; *John Blackman*, erican Cyanamid Co., New York, and *Stone*, *R. M. Banks* and *W. T. Mc-* ms of the same firm; *Fayne B. Board*, me Nickel Plating Co.; *Ernest Hamor*, me Nickel Plating Co.

The speaker of the evening was *M. C.* ler of the Ion-Exchange Products De- tment, *American Cyanamid Co.*, New k. His subject was *A Discussion of Ion-change*.

Letter to the Editor

The following letter written by Joseph Haas, Industrial Engineer, is a review of the editorial "A Way Out," appearing in the September, 1946, issue of Metal Finishing.

"A Way Out," was the title of the editorial in the September issue of *Metal Finishing*.

Primarily the editorial stated that the ways and means of lowering plating room costs lay in some form of wage incentive, piece work or bonus. By inference, rather than by direct statement, the editorial implied that the reason for high plating room costs is the day work rate paid, and that this rate is too high.

Nothing could be further from the truth. There is more than one aspect as to the cause of high plating room costs. But let us discuss the labor angle first.

Plating room costs are too high, not because the day rate is too high, but because it is too low, causing a heavy labor turnover. This heavy labor turnover results in overmanning of the Plating Department, so that the work that the Production Department has scheduled can be produced. The Production Department, which in turn has had its master schedule layed out by top management, insists that its schedules be met in order that other departments may be kept employed and meet their schedules.

It is not an infrequent sight to walk into a plating room and see twice the number of help in the department than is actually required, sitting around and waiting between tank loads. When you question the plater, the answer is "They are only getting X¢ per hour and will exert themselves only to a certain extent, so in order to keep help at that rate, I have to split up one man's work into two or three jobs. Even then someone is always quitting."

The heavy labor turnover and the overmanning of the plating room further increases labor costs. The inexperienced help cannot meet production schedules, so they are worked overtime at time and a half. So plating room costs are too high but not primarily because of the day rate, but as the consequence of day rate. Therefore the editorial hits the nail on the head in its statement: "A way of dealing with this problem in the plating room lies in a piece work system."

But, the editorial points out an obstacle to the installation of piece work or any other wage incentive plan in the statement: "Relatively few platers believe that wage incentive in a plating room is practical." Unfortunately, this statement is entirely too true, but only because the plater has not given his cooperation in making wage incentive practical, and consequently the failure of the many tried incentive plans must rest squarely on his shoulders. The plater has remained an individualist in his thoughts, actions, and the manner in which he handles his department. He still persists in surrounding his work with mystery, giving

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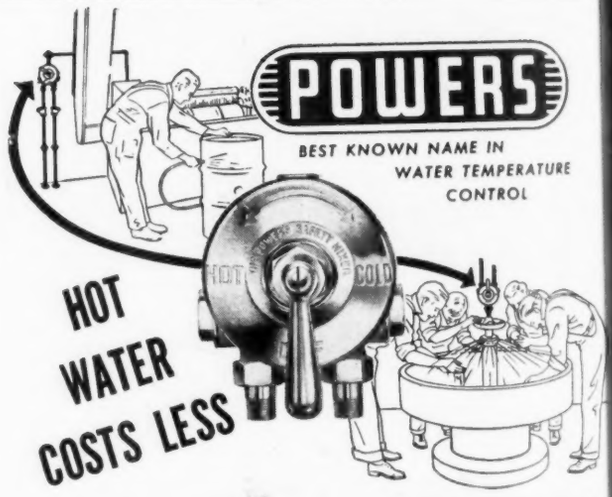

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little or no aid to time studying engineers. I would refer platers to an article published several years ago in the A.E.S. Review: "Wage Incentives as Applied to Electro-Plating," by A. L. Matthes, and also "The Application of Scientific Management in the Plating Room," *Metal Finishing* December 1943, by the writer of this article. This latter article particularly is the foundation upon which wage incentives in the plating room are or can be built.

Another phase of the editorial should be discussed: "The industry should place a hurry-up call with the industrial engineering groups to develop a competent incentive plan for that finishing pivot, electro-plating."

This statement is a contradiction of the statement: "Relatively few platers believe that wage incentive in a plating room is practical." Who else but the industrial engineers have been trying to establish wage incentives? Does the editorial imply that the present standardized wage incentive plans are impractical in plating rooms?

From personal experience, I wish to state that where and when platers have cooperated with industrial engineers, successful wage incentives have been established. The industrial engineers are not in the future going to pull a rabbit out of the hat and say: "Here is a new wage incentive plan, special for plating rooms." Each plating room is a special study, and therefore differing from power press, machining, polishing, and lacquering operations.

Therefore, if the industrial engineering groups to be called in are the same that established wage incentivs for the above mentioned operations, we will wait many, many years, as none of these industrial engineering companies have men able or capable to cope with the plater, without his cooperation.

That this lack of cooperation should exist may be the fault of top management. As previously stated, the plater is an individualist, but he may have been forced to be such, possibly, although I can not see it that way, by top management.

One does not have to visit many electroplating departments to reach the conclusion that the electro-plater is working with antiquated equipment and outmoded methods. Whose fault is that? The plater states: "Management." Here the writer must definitely take the side of the electro-plater. Management will buy all kinds of new equipment for other departments, move and re-arrange other departments for greater efficiency, which means lower costs, but when it comes to plating departments, they turn their thumbs down.

In conclusion, plating costs in order to be maintained at competitive prices without sacrificing quality and service, rests with top management, first in bringing equipment and operating methods up to date, and then insisting on the establishment of plating room wages comparable to that of the other departments in their plant. This statement does not exclude the responsibility that the electro-plater must undertake much more than he has in the past, as the efficiency of his department is what he is judged by.

To management the writer would advise: "Seek," and you shall find, "A Way Out."

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News from California
By FRED A. HERR

The *Chrome & Nickel Plating Works*, a new addition to the Southern California metal industry, opened for business at 3225 Tweedy Boulevard, Lynwood, Calif., on September 20.

Associated in the enterprise are *J. B.* and *E. E. Hamor*, who serve as production manager and treasurer, respectively, and *S. B. Board*, general manager. All three were formerly with the *Service Plating Works*, 1839 Randolph Streeet, Los Angeles.

The new plant represents an investment of approximately $15,000 for buildings and equipment. It is housed in a one-story structure built of aluminum and steel sheets and has a floor area of 21x50 feet. Production facilities consist of five copper, nickel and chrome solution tanks and six rinse tanks. The firm specializes on plating and polishing plumbing supplies on a job-shop basis.

Long Beach Plating Co., Long Beach, Calif., has installed several new 6 x 2 x 4 foot anodizing tanks for handling aluminum oil well equipment produced in the Signal Hill oil field district of Long Beach, proprietor *Calvin B. Morris* reported to *Metal Finishing*. The parts worked on consist chiefly of surveying instruments, clocks, gauges, etc.

Ex-GI Charles Sansoni is the new foreman of the company, thereby renewing an association which began when Morris taught him the plating business many years ago.

General Electric Co., Ontario, Calif., has installation underway on two elevator type conveyors in its plant for use in chrome plating flatirons. The new equipment consists of an 80-foot-long conveyor for nickel work and a 35-foot-long conveying unit for chrome.

Considerable new equipment was in process of installation in the plating department of the *Grayson Heat Control Co. Ltd.*, at Lynwood, Calif., in October. The new facilities include a fully automatic cleaning cycle and chrome plater; two five foot locally built and lined chrome tanks; six rectifiers, two vertical plating barrels, a centrifugal dryer and a production bright dipping setup with conveyor system for sulphuric acid solutions.

U. S. Spring & Bumper Co., Los Angeles, is preparing to meet the continued expansion of its postwar activity by installing some $200,000 worth of new plating and buffing equipment. The new facilities include six new automatic machines for automobile bumper polishing; four buffing tin heads; two nickel plating lines with 36 2500-inch solution tanks for work on bumper guards and bumpers; six generators and mi laneous items.

The Los Angeles Branch of the *Amer Electroplaters' Society* was represented approximately eight members in a n school class in chemistry which bega Francis Polytechnic High School under sponsorship of the Los Angeles Board Education on September 16.

The class meets every Tuesday Thursday for 1½ hours' lecture and hours' laboratory work between 6:30 9:30 p.m. The course will be car through two semesters. *Instructor C. Smith* announced that should the num of enrollees from the plating industry crease to 18 or 20, he will conduct a Fr evening class especially for the pla group in chemistry and its application the electro-plating industry.

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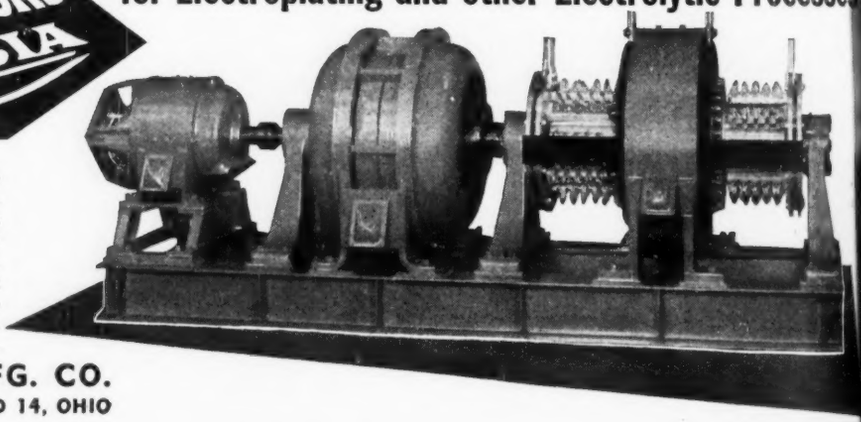

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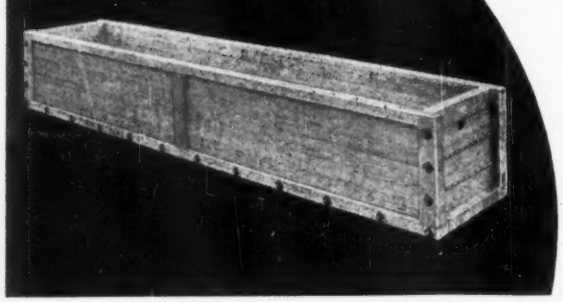

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